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The MONTHLY REVIEW

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A Society for the Advancement of the Science of Electro-Plating

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Keller—An Essay on Electroplaters Chemistry Classes	79
The Herminiea Dorothea Proctor Award	81
Vice-President P. J. Sheehan Passes Away	82
Program of First International Electrodeposition Conference in London	82
Reese—Analyzing and Controlling Metal Cleaning Operations	83
Meyer—The Orientive Effects of the Geometrical and Crystalline Structure of the Basis Cathode on the Crystal Structure of Electrodeposits	95
The Silver Jubilee and the Spirit of the Founder	111
The Silver Jubilee in New York	112
Here and There	114
The Abstract Section	119
Branch News	121
Membership Report	138
Buyer's Guide	142
Branch Directory	143

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An Essay *on* Electroplaters Chemistry Classes

By HARRY KELLER

(Foreman Plater)
Delong Hook & Eye Co.

HAVING been a member of the Electro-plating class, in chemistry, for the past ten years at the Mastbaum Vocational Evening School, my object in writing this is to tell as briefly as time and space will permit, how the class work has helped me in my place of employment.

Before joining the class my knowledge of plating was only of a practical nature. At this time I knew nothing of chemistry as it is applied to the Electro-deposition of metals. I had worked in plating shops for about ten years, and in none of these shops were plating solutions controlled by chemical analysis. To the best of my knowledge the average plater at this time, depended upon a few common tests to keep his solutions in working order. The hydrometer was used to determine the metal content. Litmus paper was used to show the acid and alkali contents of solutions. A common practice was to take a small quantity of solution, and hold it up to light. The turbidity or clarity of the solution was then taken into consideration. These tests were not very dependable, and were mostly guess work. However some of the older platers had very good results with these methods.

When the first Chemistry class was started, I was working as Mr. Gehling's assistant, at the Delong Hook & Eye Company. Mr. Gehling, who was one of the founders of the class, suggested my joining it.

Mr. A. Hirsh, the class instructor, planned the lessons in such a way as to greatly simplify the work. We started with some elementary chemistry, such as the Atomic and Molecular

weights and symbols of chemicals. This was followed by lessons in making the analysis of the different plating solutions. This included standard solutions used for titrating. Among the solutions the class was taught to analyze, was the nickle solution to determine the content in grams per liter and ounces per gallon of metallic nickel and chlorine. The Brass solution for the determination of zinc, copper and free cyanide. Also the gold and silver solutions for the metal content and free cyanide. Cadmium, acid and cyanide copper, and chrome plating solutions were also analyzed. The chromic acid in a chrome plating solution may also be determined by using a hydrometer. A reading is taken either Sp, Gr, or Be and by consulting a table given us by Mr. Hirsh, the Chromic Acid in ounces per gallon is found. In all this work I have taken an active part and have made a complete analysis of these solutions.

Many lectures were given by Mr. Hirsh. These lectures included talks on Anode and Cathode efficiency in the plating tank, the current density of solutions, Ohms and Faradays laws. The E M F in plating solutions, meaning the volts and amperes, and the resistance in solutions. The way to construct and use a copper culometer was shown. This apparatus is used to determine the cathode efficiency of a solution.

Instructions in making and using a Potentiometer was given. This instrument is used to give the pH of a solution or Hydrogen in concentration of a solution.

Lectures given by Mr. Hirsh so far this year, are of great value to the plater as they deal directly with the every day problems in the plating room. There were many lectures given which space does not permit me to mention in this paper.

In August 1935, Mr. Gehling resigned his position as Foreman of the Finishing Department of the Delong Hook & Eye Company to take a position in the chemical supply business. I was then given charge of this department. I am holding this position mainly because I took an interest in whatever instruction I received in this class.

Feeling that I would like to make use of what I had learned at school, I went to my employers and suggested that they buy the equipment necessary to analyze our plating solutions. They did this, and I am now controlling most of our solutions

by analysis, I give much credit to Mr. Hirsh and the school for this.

Aside from the regular school work there is however, another side of the story, in regard to the class, which is well worth mentioning. It gives the platers of the different plating shops a chance to get together on school nights, and discuss the problems which come up in the plating rooms. Some of the older men such as Mr. Gehling and Mr. Hirsh and others, are always willing to give helpful advice. All that is necessary is regular attendance at the classes. This is of particular value to the younger men. I feel that this class has helped me immensely in my work, and I will continue to attend the class.

I will say in conclusion that I give very much credit to the Philadelphia Branch of the American Electro-Platers' Society for making this class possible. Also to the Board of Education and the Heads of the Mastbaum School, Mr. Robinson and Mr. Ball. These men take a great interest in our class.

THE HERMINIEA DOROTHEA PROCTOR AWARD

The founder of our Society, Mr. Charles H. Proctor of Clearwater, Florida, in his Editorial appearing in the January REVIEW very generously decided to create an award of one hundred dollars to the author of the best paper presented at the New York and future Conventions during his lifetime.

The award is to be known as the Herminiea Dorothea Proctor Award in memory of the late Mrs. Proctor who died October 10, 1934.

In a recent letter Mr. Proctor added "that the award should cover the entire membership active and associate, and later if the award committee should suggest an open field, viz. A. E. S. membership or otherwise it will be satisfactory to me."

Assuming of course that the Executive Board will recommend the adoption of Mr. Proctor's splendid gift, we take this opportunity of thanking the donor on behalf of our entire membership. We are sincerely hoping that the founder of our organization may enjoy many more years of happiness and prosperity and see the fulfillments of his vision gradually unfold, regarding the activities and achievements of the electroplaters' society, which he started twenty-five years ago.

Our members will be glad to know that our good friend George B. Hogaboom is convalescing nicely from his recent illness and is able to resume his work. The best wishes of all our members are extended to George for a complete and speedy recovery.

Los Angeles Branch A. E. S. will hold a West Coast Convention of Electroplaters and Exposition of Plated Products on March 20th, 1937, at Elks Temple, 607 South Parkview Street, Los Angeles, California, with an Educational Session at 1 p.m. and Dinner Dance at 6:30 p.m. to which all Platers and Plant Representatives are cordially invited.

VICE-PRESIDENT P. J. SHEEHAN PASSES AWAY

Most of our members have learned with sorrow and regret that First Vice-President P. J. Sheehan of Milwaukee, died quite suddenly on Saturday, January 9, 1937. Although born and educated in Connecticut, Mr. Sheehan had lived in Milwaukee for twenty-five years, where he was affiliated with The Cutler Hammer Co., as foreman plater. For many years "Pat" as he was familiarly called, attended the A. E. S. Conventions; he was well liked for his fair and honest convictions which he was never afraid to express. His devotion to the ideals of the A. E. S., his strong desire to help the young fellows interested in electroplating and his good natured disposition always made him popular with the platers. Milwaukee Branch in particular and the Society in general have both lost a hard worker, a progressive leader and a genuine friend in the passing away of Mr. Sheehan.

We desire to express to Mrs. Sheehan and the two boys, Vincent and Edward our sincerest sympathy in their time of sorrow.

First International Electrodeposition Conference

LONDON, MARCH, 3rd and 4th 1937

PROVISIONAL PROGRAMME *Subject to revision*

PROVISIONAL LIST OF PAPERS

"Nickel Plating in France," M. Ballay (Fr.). "Degreasing with Alkali Cyanides," A. Chaybany (Fr.). "Anomolies in the Microstructure of Electrodeposited Metals and their Influence on the Mechanical Properties," Michel Cymboliste (Fr.). "British Electroplating Practice," E. J. Dobbs (Br.). "Studies in Evaluating the Brightness of Electroplating," Dr. B. Egeberg (U.S.A.). "The Theory of Cathodic Deposits from Complex Salt Solutions," Prof. Ing. Dr. Techn. A. Glazunov (Czechoslovakia). "Zinc Plating," Dr. A. Kenneth Graham (U.S.A.). "American Electroplating Practice," George B. Hogaboom (U.S.A.). "Methods of Producing Adherent Deposits on Nickel and Chromium," A. W. Hothersall and G. E. Gardam (Br.). "Industrial Electrodeposition of Zinc and Cadmium and Laboratory Investigations of these Processes in U.S.S.R.", Prof. Dr. N. Isgarisheff (U.S.S.R.). "Comparative Properties of Metallurgical Surfaces Polished by Mechanical and Electrolytic Processes," "The Application of Electrical Polishing to the Study of Metal Deposits," M. P. A. Jacquet (Fr.). "Modern Electroplating Machinery," Dr. John Kronsbein (Br.). "Recent Developments in the Electrodeposition of Tin," D. J. Macnaughtan (Br.). "The Crystal Structure of Copper Deposited from Cyanide Solutions," Prof. Arthur Phillips (U.S.A.) and W. R. Meyer (U.S.A.). "Optical Research of Thin Layers," Prof. L. S. Ornstein (Holland). "Modern Developments in the Electrodeposition of Gold," H. W. J. Pope (Br.). "Contribution to the Study of the Throwing Power of Electrolytic Baths," Prof. Albert Portevin (Fr.). "Chromium Plating from Non-Chromic Acid Solutions with Chromium Anodes," Prof. Dr. Ing. Max. Schlötter (Ger.). "Deposition of Platinum Group Metals," Dr. Carl Schumpelt (U.S.A.). "History, Development and Application of Cadmium for Electrodeposition," Gustaf Soderberg (U.S.A.). "German Electroplating Practice," Dr. Richard Springer (Ger.). "Zinc Plating of Strip—Standard Methods of Electrodeposition," "Copper Plating on Textiles," "Technical Training for Electrodeposition in U.S.S.R.," Director A. M. Yulin (U.S.S.R.), Dr. Kydriatzev (U.S.S.R.), Eng. Shviriaev (U.S.S.R.). Also papers by the following authors: Prof. Jean Billiter (Fr.) "Resumé of Silver Plating," Frank C. Mesle (U.S.A.).

Analyzing and Controlling Metal Cleaning Operations

By MR. T. W. REESE
of the Oakite Products Co.

Read before Springfield Branch Nov. 1936

LONG before this day of streamlined automobiles, and 200-mile-an-hour passenger airplanes, the electroplating industry had intricate and interesting problems and operations. But the requirements today are even more demanding. The scope of electroplating has broadened so tremendously that it is amazing to picture the great variety of metals, solutions, finishes and intricate operations which are now handled by electroplaters and the knowledge and experience which lies behind this work.

The requirements for adequate and practical cleaning of metals have likewise multiplied. So that today, the analyzing and controlling of metal cleaning operations is a very broad subject. I do not expect in this paper to cover every angle or every detail. It is my hope, however, to be able to leave some definite thoughts which may be helpful on the subject; to outline clearly some of the methods of procedure which have been found to lead to the solution of cleaning difficulties or the establishing of a practical, economical and trouble-free cleaning operation.

GREAT VARIATIONS MUST BE DEALT WITH

A first consideration is to get a clear picture of the physical characteristic of the parts to be handled. Electroplating covers the range from parts so small as to almost require a glass to see them, up to such large parts that they are handled in over-sized equipment or sometimes plated by sections. Some parts are more or less flat and other parts deeply recessed. Hollow-ware, for example, has required special handling for electroplating in order to get the solutions to properly throw the plate onto all surfaces desired. Screw threads and sharp angles sometimes require special study.

The matter of cleaning has also had its many different requirements so as to give proper results for the particular parts in question. There are so many different cleaning problems that as a first working principle it has been tackled on the basis that every problem is different.

This working principle, however, need not leave the matter in as confusing a state as it might sound. It has been possible to establish both by Laboratory experiments and by plant experience orderly methods for analyzing a cleaning operation, for determining what types of materials should be most suitable for the particular work in question and for outlining most effective handling procedure and equipment. What are some of the main factors to take into consideration?

VARIOUS METALS

Naturally, one of the first factors which we recognize is the type of metal or alloy to be cleaned and plated. It may be that there is large production on just one type of part and metal and a highly specialized method can be worked out for just those parts. Or we may have to deal with many different parts and metals as in a job shop, in which case the electroplating and the cleaning must both be flexible so that they can be adapted for most any job which must be put through the shop. Electroplaters really do marvelous work in this country when we realize what is demanded of them. When designers and mechanical engineers are designing all sorts of metal objects, they select from a tremendous range of metals and alloys because of varying demands for mechanical strength or workability, lightness or durability, decorative value, etc. Then you gentlemen are asked to put dozens of different types of plates and finishes on these parts. So it becomes necessary to clean and electroplate such metals as:

Steels, low carbon
Steels, high carbon and special
Cast iron
Brasses of all sorts
Bronzes of various compositions
Aluminum alloys

Die-castings of many types
Copper
Magnesium alloys.

As to cleaning this range of metals, it is necessary not only to provide adequate cleaning to give the necessary chemically clean surfaces, but also to guard against undue tarnish on brasses, attack or oxidation on aluminum alloys and other soft metals, electrolytic action during cleaning. This has resulted in much laboratory research and field experimentation so that these various metals can now be classified into various groups on a very sound basis with several types of cleaning solution available for each general type of metal. The steel and iron group may be handled in one manner, brasses, copper and bronze handled on a little different principle with due regard for tarnish, and a specialized series of solutions for the aluminum, magnesium and die-cast metals which we term "soft metals". Where metals of these different groups must be cleaned in the same solution, it is also frequently possible to work out a compromise satisfactory to all, but on large production it is generally preferable to segregate the cleaning of the various groups so as to apply the most effective solution and method for each radically different type of metal.

TYPES OF FOREIGN MATTER

An equally important question is the types and quantities of foreign matter to be removed from the parts. Articles coming to the plating room are covered with a wide range of varieties of dirt and foreign matter. Some of the principal items encountered in these various cleaning operations are:

Mill scales
Rolling oils
Drawing compounds
Stamping compounds
Cutting and Machining Compounds
Grinding compounds
Buffing compounds
Oxide films
Tempering and Quenching oils
Finger greases
Shop dirt and dust

Fortunately, many of the oils and greases applied to the articles during manufacture, such things as cutting and drawing compounds, can be handled easily with simple equipment in hot solutions with very little labor and with certainty of good results. Mineral oils, of course, cannot be saponified, but can practically all be removed with little difficulty by solutions which have the ability to emulsify them. The surface tension of these oils is thereby greatly reduced so that they lose their tendency to stick to the metal surfaces and they come off in the cleaning solutions.

Scales and oxides, however, require some sort of chemical attack to dissolve and combine with them as so to leave a new oxide-free metal surface. Acid dips and bright dips have been the answer to most of these problems.

Buffing and polishing compounds will generally yield to rather simple cleaning equipment and method using a cleaning solution with good emulsifying powers. This is sometimes quite a problem, however, because the buffing compound is driven into recesses and crevices and the heat of friction during the buffing leaves the compound clinging very tenaciously to the metal surfaces. Buffing compound which is very readily cleaned off comparatively flat surfaces, may still give difficulty or require some hand brushing or other special treatment when slugs of that compound are forced into small crevices of the parts or when excessive amounts of buffing compound are used and left on the parts in lumps. Sometimes you can eliminate a cleaning trouble or prevent it merely by a little caution or training of the buffing operators to use only the minimum of buffing compound necessary.

There are types of unusually difficult cleaning work where, however, it is economy to employ a newer type of cleaning process which involves multiple cleaning baths. For example, there is a problem where it is desired to eliminate the hand scrubbing which has frequently been employed to remove the carbon smut which clings so tenaciously to cold rolled steel; or such a problem as brass shower bath heads where the buffing compound imbeds in the very small spray holes and will not ordinarily soak out from the holes but had to be punched out of each hole by hand. A comparatively new type of process and material known as the Saturol Process has been developed

to handle these types of problems, to eliminate the hand brushing which was previously necessary. We might term this as a three-step cleaning operation. There is first a dip of the parts into a cold tank of a special material, Saturol, which prepares the parts for the actual cleaning. This first material does not, in itself, remove the foreign matter, but it leaves a coating on the foreign matter of such a type that it will yield and come off in the more ordinary type of cleaning solutions. Following a short dip, the parts are allowed to drain over the tank.

The second step is then a cold water rinse. The purpose of this rinse is to not carry too much of the first material into the regular cleaning tank. A strong spray rinse is recommended rather than a rinse in a tank.

Even though it may be a little trouble and cost a few dollars to install a spray rinse with several good nozzles and a foot treadle valve for easy operation, this is strongly recommended. From actual experience, this form of rinse for this special method will more than save its cost in a short time as compared to using a rinse tank.

The third step of the process is to put the parts into the hot solution of the more general type of cleaning material. While this involves two different types of cleaning materials and therefore some extra equipment and handling, it does very wonderful work in many instances in eliminating laborious scrubbing of certain parts or types of dirt which previously could be removed only with brushing. Fire hazard is also eliminated as this method makes unnecessary the use of any inflammable solvents. To review this method briefly, there is first a dip in the unheated Saturol, then a quick rinse in plain cold water and then a final cleaning in the regular cleaning tank to obtain the chemically clean surface for plating.

MECHANICAL STUDY

The mechanical study is another angle which throws much light on cleaning operations or difficulties. There is the question of the articles themselves and of the equipment for cleaning and for plating them.

The shape of the parts naturally has a great deal to do with

the handling. Some angles of this are very simple. The size of the parts and quantities of the various sizes quite readily determine whether the pieces are best handled in baskets or on racks or trees or whether they are wired up individually. With quite small parts, the cleaning is sometimes economically and easily done by a method of tumbling just as the plating is handled in that way. One important point to observe is whether or not the parts are of such a shape as to carry out portions of the solution in pockets and recesses. For instance, if parts are cupped or have recesses and pockets, they may carry out very appreciable amounts of the cleaning solution. Preventing this carry-out will not only make the cleaning operation still more economical, but will prevent contaminating the rinse tank. Naturally, a cold running rinse is generally employed so that every trace of foreign matter and of the cleaning material itself is removed before the parts go to the plating bath. But if the parts are pocketing a good deal of cleaning solution and are carrying it into the running rinse, then this is not really a clean water rinse and trouble may develop no matter how free-rinsing a cleaning material there may be in the cleaning tank.

A few simple experiments very quickly show whether or not the articles will carry out much solution if put in certain positions. If they do, then a few more experiments should show which is the correct way to place the parts in the baskets or what sort of racks should be designed to prevent carrying over from one solution to the other. Then a little training of the operators to stack or rack the parts in exactly the right position will well repay the effort by less expense and preventing troubles from carry-over and contaminated solutions.

Heating facilities and sometimes means of circulating solution of cleaning tank are apparently simple factors, but are nevertheless very important to check over. There should be not only provision for sufficient heat to provide a full strong boil, but it is advisable to have good means of control because on some types of parts and metals or for certain working conditions, it is sometimes found that better results are obtained by maintaining lower temperatures. Cleaning tanks should be so planned as to provide good drainage facilities and made easy to scoop out any dirt which has settled on the bottom when the tank is drained.

Naturally, heating coils should be on the side and not on the bottom so that the tank can be readily cleaned out and to prevent solid matter from packing around the heating coils.

Electric cleaning (the passing of the current through the cleaning solution) is another mechanical angle which is very helpful on some types of cleaning work. Where a cleaning tank is being equipped for electric cleaning, two recommendations are particularly suggested. First, separate steel anodes should be supplied and insulated from the tank in preference to connecting the tank itself to one pole of the current. Second, put a double pole, double throw switch in the circuit, with cross connections on the switch so that in one position the current flows from the steel anodes to the work and in the other position the current is reversed. It has frequently been found that the use of current through the cleaning solution greatly improves the cleaning work, but that the use of the double throw switch or reversing the current gives a still further improvement. The probability is that after the current has flowed in one direction for a brief time, the work has become coated with bubbles of gas and is largely insulated, thereby reducing the current flow and reducing the agitation of the solution. By a brief reversal of the flow of the current, the coating of gas bubbles disappears and the cleaning solution can then again get actively at the surfaces of the work to be cleaned.

The development of semi-automatic or full-automatic equipment for large production work has been marvelous and has brought in some interesting problems both for the Plater and for the cleaning service man. Where large quantities of parts are going to pass automatically through cleaning tanks, then rinse tanks, then plating tanks on a predetermined time schedule, there must be a very well grounded basis for planning the length of time of parts in each tank, the temperatures, the solutions to be used and such factors to be sure that the parts will run through with perfect results in all steps. On large full-automatic machinery, the most intelligent cooperation is needed between the electroplater, the manufacturer of the equipment and the manufacturer or service men of the cleaning materials and other supplies used in the equipment.

In that connection, a good practical service laboratory is frequently of great use. Such a service laboratory should be equipped, in addition to having some men who have practical cleaning and plating knowledge, with plating apparatus for various solutions, cleaning tanks for a wide range of cleaning materials and all other items available in the average plating room such as steam, compressed air, low voltage direct current, bright dips, buffing wheels, etc. With such a laboratory to which the cleaning service men can refer problems and send quantities of typical samples of work to be cleaned, the cleaning material manufacturer is in a position to make recommendations based on practical facts.

If supplied with a good quantity of typical articles which have on them the types of foreign matter in the condition that they will be in regular production, then his service laboratory can pretty safely tell what solutions will properly clean these parts for electroplating, what concentrations and temperatures will be necessary and to work out a correct program in advance. This is the type of practical information which is helpful for most any plating operation, but it is doubly important where full-automatic cleaning and plating takes place.

SUMMARY OF ANALYSIS

The foregoing outline of a number of the important factors in a cleaning operation illustrate one method employed in the practical working out of cleaning operations and problems. We must get the full knowledge of all working conditions and then of the requirements. I will recall that among other things, we have to take into consideration first the type of metals or alloys, then the type or types of foreign matter and dirt to be removed, then the shapes of the parts themselves, then the various mechanical factors such as equipment and handling of the parts and then the quantities of the parts and whether certain mechanical or automatic features would be justified.

STEPS AFTER ANALYSIS OF PROBLEM

Having pointed out that there are so many factors affecting a cleaning problem, many of which you gentlemen, of course, are familiar with, does this now leave us all at sea as to what to do next. Fortunately, it does not.

By splitting up the cleaning operation in question into many different factors — metals, dirts and foreign matters, shapes and sizes of parts, equipment, handling method, production requirements, etc., we can get a clearer grasp of just what step to take, just what the final solution will be. From experience and laboratory information, for example, types of metals give us a starting point, shapes of parts suggest certain handling conditions, types of foreign matters given another clue, production requirements dictate certain suggestions, etc.

Considering each of these factors separately as compared with other experiences and then putting these bits of knowledge together, generally shows that each particular cleaning operation we are considering can be classified in a type which can be handled by standard solutions and with certain methods upon which data is already available.

For the very special problem on which the cleaning service man has no sure information available, there is still a manner of working this out. The procedure is that the Field man can write a full report of the whole problem, send a good supply of samples of the articles and of the foreign matter to be removed, to a service laboratory and then that laboratory having available all the various equipment generally present in a plating room, can make experiments until arriving at a practical solution to the problem. In other words, gentlemen, when we fellows in the Field get stuck, thank goodness, we can holler for help and the home laboratory will throw us a life preserver.

CONTROLLING CLEANING OPERATIONS

So far I have dealt with the first part of this question of Metal Cleaning.... the analyzing of the problem and arriving at the most economical and systematic manner for doing the cleaning work. The second half of the problem, the means for *keeping* these operations going along in a smooth and trouble-free manner is equally important. But I can relieve the minds of you gentlemen by saying that this second half of the subject can be covered in only a very few minutes.

After the analysis, investigations and experiments have established a set of orderly handling methods, which gives satis-

factory and economical cleaning, then it is the natural desire to be able to maintain a set of balanced working conditions. This is so as to keep the work coming through at the rate required with minimum rejected parts and doing so with the greatest all around economy. Therefore, means for *controlling* the various factors of the cleaning operations are to be provided.

For example, on a typical type of cleaning being handled, let us say, through a good heated cleaning tank followed by a running rinse, there are three important factors to maintain. These are the *temperature* factor, the *time* factor, and the *cleaning strength* factor.

Working temperature is naturally an important consideration in connection with the cleaning solution. It is very easy to get many degrees away from the most effective working temperature without realizing it, unless some easy means of control is provided. It may be that the best working temperature was originally found to be between 205°F and boiling. Vapor will rise from tanks at a great many degrees below that temperature and might lead us to believe that they are near enough to boiling. I have been fooled on this a number of times. Regular temperature check-up is recommended and such an instrument as this one known as the Oakite Heat-Clean Meter, makes it very easy for us to check up heating of all tanks whenever necessary. This was especially designed by our Company for the convenient use of its Field men. It combines accuracy, ruggedness and ease of reading. It is found that temperature check-ups are made much more frequently with this heat-clean meter than previously when carrying thermometers.

The time factor is also a very simple fundamental and yet should not be neglected. When it has been found that a certain amount of soaking time is advisable in the cleaning tank, it is generally best to arrange a little time schedule with a safety factor of a little added time. Or it may be that with delicate metals or metals which are likely to tarnish that caution is necessary to *limit* the length of soaking time. In any case, when the best length of cleaning time has been determined, it is advisable to have the operators trained as to that length of time. If there is a clock available to the easy view of all in the plating room, the operators can be readily trained to fairly accurately adhere to the length of time which you know is best.

The cleaning strength factor can also be easily controlled to maintain standard working conditions. Having determined on a cleaning solution which satisfactorily meets the requirements and gives a suitably chemically clean surface, proper free rinsing, satisfactory length of life, no detrimental effects on the pieces, and economy, it is then desirable to maintain that solution in as near its original condition as possible. Naturally, there must be additions of the cleaning material from time to time to replace material carried out or to offset the gradual reduction of cleaning ability which is bound to take place. The question is how can we determine how much material to add to the cleaning tank and how often?

An equipment of this type known as the Oakite Titrating Equipment, provides the means. Tests of the cleaning solution can be made at regular intervals and will indicate the amount of cleaning material necessary to add to bring the solution back to its original working condition. Entries can be made on these cards showing each test made and the concentration in ounces per gallon at the time of the tests. Such a card record of a cleaning tank will give a very good accurate history of its operation. I want to make clear that this equipment is not intended for making comparative tests between different cleaning solutions, it is not a cure-all to indicate all the different factors entering into a cleaning solution. But it does serve the very useful purpose of making tests to show how much a certain known cleaning solution has been used up from its original condition and therefore how much of that same material should be added to bring it back to standard working strength.

The equipment is quite flexible in its application, as it can test the condition of quite a wide range of cleaning solutions used for electroplating. Its use gives infinitely better control than guessing or some rule-of-the-thumb method of merely added so many pounds of material once a week. If the cleaning solution has not been overworked this test will indicate that it is nearly up to full working strength and it would be only wasting money to add a lot of cleaning material. It prevents trouble from overloading a tank with cleaning material. On the other hand, if there has been an excessively heavy run of work, the results will be indicated by the test and it will give us a gauge as to how much material should be added.

That reminds me that it is much more effective to add small amounts of cleaning material frequently, say several times a week, than to add a larger amount to the tank at long intervals. The frequent addition of small amounts keeps the cleaning solution at the best standard working strength. It will give more uniform satisfaction and will save money to operate it in that way.

I have tried to outline specifically some of the factors to be studied when attempting to improve a cleaning operation or to get a new cleaning operation into production. Preparation of metals for electroplating can sometimes be the most troublesome operation in a plant. I don't claim to know all about the subject. But, from experience, cleaning operations can be worked out and controlled on a sound basis along the principles I have outlined and can become the least troublesome thereby giving more time for plant men to study and experiment on the many other new and interesting developments that are constantly taking place in the Plating Industry itself.

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4 P. M. Mr. W. M. Phillips of the General Motors Research Staff will show the Pictorial Projectoscope, showing plating solutions at work on the screen. Subject will be "The Actual X-Ray of Plating Solutions."

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BERT W. SAGE, *Publicity Committee.*

The Orientive Effects of the **Geometrical** *and* **Crystalline** *Structure of the Basis Cathode on the* **Crystal** *Structure of Electrodeposits*

By WALTER R. MEYER
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Bridgeport, Connecticut

Read at Cleveland 1936 Convention

INTRODUCTION

THE X-ray, microscope, and the electron diffraction camera have been useful tools in the substantiation of Huntington's suggestion, 31 years ago, that the basis metal had a noticeable influence on the crystalline structure of the metal electrodeposited upon it. The small-scale geometrical condition of the cathode plays an important part in determining the orientation of the crystals in the electrodeposit, but larger geometrical configurations may super-impose their effects upon the structures resulting from the small-scale conditions. These effects are more noticeable with multiple coatings and they will be strikingly illustrated by photomicrographs of multiple nickel and cadmium coatings. A photomicrographic study of the limiting current density for continuation of the structure of the basis metal by electrodeposit has been made for copper on copper with a correlation of the grain size of the basis cathode and with a consideration of the small-scale geometry of the basis metal. Limited observations have been made for nickel on nickel, cadmium on cadmium, and zinc on zinc, but detailed descriptive results will not be included because they can be more clearly depicted by lantern slides of the photomicrographs.

SURVEY OF LITERATURE ON RELATED SUBJECT MATTER

As in the phenomena of phase changes from the liquid to the solid state, such as in solidification, the structure of the resulting solid, either from freezing or electrodeposition, depends upon two factors:

(1) *The Rate of Inception of Crystalline Centers* N_c, or in other

words, the number of crystalline nuclei forming in unit time per unit of volume or surface.

(2) *The Rate of Crystal Growth* V_c, or the rate of increase of the boundaries enclosing any one crystal lattice. This rate is vectorial, with the rate of crystal growth being, in most cases, most rapid normal to the surface of the cathode and much slower parallel to the surface of the cathode or at right angles to the direction of current flow. Most electrodeposits are decidedly anisotropic crystallographically and exhibit fibrous or columnar structures. The fineness, form, and orientations of the crystals of the electrodeposit depend upon the relative magnitudes of N_c and V_c and these variable in turn, depend upon the following:

(1) The condition of the cathode or the support of the deposit.

(2) The conditions external to the cathode which are many and inter-related; namely, current density, concentrations of the constituents of the solution, temperature, ionic concentration of the metal, rate of stirring, pH, complex ion formation, presence of colloids, etc. By variations in these factors, the relative magnitudes of N_c and V_c can be controlled, although in certain cases, one factor such as complex ion formation may considerably diminish the magnitude of the effects of the other variables.

THEORIES FOR THE EFFECTS OF COLLOIDS ON THE CRYSTAL SIZE OF ELECTRODEPOSITS

Colloids have pronounced effects on the relative magnitudes of N_c and V_c and no one theory can account for the pronounced effects of colloids on the grain size of electrodeposits. R. Taft[2] reported that there are two types of colloidal addition agents; namely, (1) which is co-deposited with the metal and included in the deposit, and (2) which is simultaneously reduced with the metal and is not included with the deposit. H. J. Sand[3] considered the relationships between gold number and absorption and the effectiveness in changing the microstructure of electrodeposits, but could come to no clear-cut conclusions.

Much work has been published attempting to correlate cathodic polarization changes caused by the colloidal addition agents with the decrease in grain size of the deposit, and this phenomenon

appears to be the chief reason for the brightening effects in many solutions. W. Blum[4], however, showed that whereas gelatin increased the cathodic polarization in copper and zinc solutions where it acts as a brightener, carbon disulphide in silver solutions and sodium thiosulphate in copper solutions decreased the cathodic polarization although they act as brighteners in the respective solutions. In a study of copper solutions, B. Clark and E. O. Jones[5] found that all addition agents which caused a decrease in grain size also affected an increase in cathodic polarization and a decrease in conductivity. For a smooth, fine-grained deposit, they concluded that the cathodic polarization should be a large fraction of the applied E. M. F.

Shikata and Hosaki[6], using a dropping mercury electrode, obtained an increase in the deposition potential for sodium upon the addition of gelatin.

C. Marie and R. Audubert[7] summed up the major effects of colloids by stating that colloids act as brighteners in acid baths with electrodes such as lead, zinc, or copper which exhibit overvoltage phenomena. Colloids increase the potential difference at the electrode thus increasing the rate of crystal nuclei formation as compared with the rate of crystal growth. Colloids absorb ions of the electrolyte and complexes cause increased potential differences.

In a recent paper, Seiji Kaneko[8] expressed the view that smaller crystals are obtained when the interfacial surface tension between the solid and the liquid is small because nuclei form more readily when the interfacial surface tension is low. Hence smaller crystals are deposited from strongly absorbing solutes. Many addition agents lessen surface tension and complex ions are absorbed more readily than simple ions.

The conditions external to the cathode have, therefore, pronounced effects upon the structure of the deposit and these conditions may be such as to prevent the extension of the crystal structure except for a short distance. The extension may not be visible metallographically in some cases, but X-ray studies have shown that orientation of the first crystals deposited occurs even at current densities at which N_c is greater than V_c.

The conditions of deposition favoring extension of the crystal

structure of the basis metal by the electrodeposit are: high metallic ion concentration, low current density, stirring, or in general those conditions favoring low cathodic polarization.

PUBLISHED DATA ON THE EXTENSION OF THE CRYSTAL STRUCTURE OF THE BASIS CATHODE BY THE ELECTRODEPOSIT

Huntington[1] first called attention to the fact that the microstructure of the copper deposit could be influenced by the structure of the copper upon which it was deposited. In 1916, G. B. Hogaboom[9] mentioned difficulties from coarse silver deposits traceable to the influence of the basis metal, and in 1921[10], he pointed out that one of W. Blum's photomicrographs of alternately deposited metals showed reproduction of the rolled copper base in the electrodeposit. Two years later, W. Blum and H. S. Rawdon[11] published photomicrographs which showed clearly the extension of the crystal structure by electrodeposited copper of the structure of cast, and annealed rolled copper. Shortly afterward, A. K. Graham[12] repeated these observations for copper on copper, and was successful in obtaining similar results for copper on brass but was uncertain as to the results for nickel on nickel. A. W. Hothersall[13], in 1933, published a photomicrograph of nickel electrodeposited upon nickel where a distinct extension of the basis metal crystals into the electrodeposit was visible. Perhaps the most brilliant work on this phenomenon was published by Hothersall[14] in March, 1935, at the symposium of the Faraday Society on the structure of metallic coatings, films, and surfaces. One of the greatest obstacles in a study of this kind is the etching of the electrodeposit without attacking the structure of the basis metal or vice versa, and Hothersall solved this problem by protecting each zone by coating them successively with a protective varnish. The excellent photomicrographs which he published are sufficient testimony as to the success of his technique. Nickel electrodeposited upon nickel, tin upon tin, and tin upon 1% antimonial lead alloy followed the structure of the basis metal. His results showed that a continuation of the basis metal structure is possible, (a) when the deposit and the basis metal belong to the same crystal system over a range in lattice parameter differences from −2.4% to plus 12.5%, and (b) when the deposit

and the basis metal belong to different crystal systems. Thus tetragonal tin was shown to continue the structure of face-centered cubic copper, and copper to continue the structure of body-centered cubic Beta brass.

W. A. Wood[15], using X-rays, studied the crystal orientation of copper and nickel on copper cathodes. Orientation occurred when the cathode surface was clean and when the current did not exceed 11 amperes per square foot. With nickel electrodeposits, a fiber type of structure resulted with current densities up to 7 amps./ft^2. which disappeared between 7 and 9 amps./ft.^{2}. Above 9 amperes per square foot, the deposit was similar to the copper base up to 35 amps./ft.^{2} and orientation completely disappeared at 55 amps./ft.^{2}. No explanation for the anomolous results was offered.

Irmgard Chiout[16] obtained similarly anomolous results for the deposition of copper upon a single crystal of copper.

Stillwell[17] obtained orientation of electrodeposited silver-cadmium alloys, Per Frölich and G. L. Clark[18] deposited nickel upon nickel with extension of the crystals of the basis metal and found that hydrogen interfered with the development of the crystals, and Foerster and Klemm[19] were successful for cadmium on cadmium, zinc on zinc, and lead on lead. Tammann and M. Straumanis[20] reported extension of the crystal structure of nickel by copper if the current did not exceed 2 amps./ft.^{2} during the deposition of the copper.

DEPOSITION OF COPPER UPON COPPER

Copper was deposited from a solution containing 200 grams per liter of copper sulphate and 50 grams of concentrated sulphuric acid and the temperature was maintained within $\frac{1}{2}$ a degree of 100°F. The cathode was annealed copper rod $\frac{3}{4}''$ in diameter with $1\frac{1}{2}''$ of exposed copper. Both ends of the copper rod were coated with lacquer so that the current density would be uniform. The specimen was etched in 1:1 nitric acid to expose the structure of the undistorted crystals to the electrodeposit. The usual metallographic wheel technique was employed and the most satisfactory etch was found to be 10 grams

of ammonium persulphate in 100 cc. of 20% aqueous ammonium hydroxide. Polish-etching was found to be much superior to immersion etching or swab etching.

Straight, columnar, unbroken copper crystals grew from the basis copper metal when the current density did not exceed 10 amps./ft.^{2}. Twinning in the basis metal was reproduced in the electrodeposit and lines similar to slip bands were clearly visible in the twinned portions giving a herringbone-like structure. The crystal structure of the basis metal was reproduced by the electrodeposit up to 25 amperes per square foot but the unbroken columnar crystals broke up when the current density was above 10 amperes per square foot. From 0 to 10 amperes per square foot, V_c is decidedly greater than N_c and from 10 amperes per square foot to 25 amps./ft.^{2}, N_c and V_c are nearly equal while above 25 amps./ft.^{2}, N_c is decidedly greater than V_c.

It has been determined for copper that under the same conditions of current density, temperature, etc., the factors which determine the probability of growth of the basis metal crystals by the electrodeposit are: the size of the basis metal crystals, the orientation of the planes of densest atomic packing (for copper the octahedral), and the direction of current flow. When copper is deposited upon a single crystal of copper, preferential deposition results upon the (111) plane and it follows that in deposition of copper upon polycrystalline copper those crystals of the basis metal that have their octahedral planes oriented normal to the direction of current flow will grow preferentially provided other conditions are the same.

It has been observed that larger crystals may orient the electro-deposit whereas smaller crystals may not be extended into the electrodeposit. This phenomenon may be compared to germination or grain growth in which the larger grains grow at the expense of the smaller grains due to the larger grains having greater mass orientive forces. The process of germination is diffusion across an interface between solids, whereas deposition is diffusion of a metallic ion from a solution across an interface of depleted metallic ions to a solid to take up its position in the lattice although true equilibrium may not be obtained as evi-

denced by the strains present in the electrodeposits. In summary the conditions of the crystals of the basis metal which facilitate growth by the electrodeposit are: orientation of the planes of densest atomic packing perpendicular to the direction of current flow, and large grain size. Poorest extension of the basis metal crystals will result when the grain size is small, and when the long axis of the basis metal crystal is other than 90° to the plane of the basis metal as well as when for copper the plane cuts through a direction other than the octahedral. The most suitable conditions for grain growth of copper deposited upon copper are relatively easy to obtain because of the prevalence of the (111) plane whereas for zinc the most suitable conditions are much more difficult to obtain because zinc has the hexagonal close-packed crystal structure with the densest packed plane being the basal or (0001) plane. Difficulty was experienced in depositing zinc from acid solutions upon large-grained cast zinc even at low current densities (below 5 amps./ft.^{2}) so that the crystal structure of the basis metal would be extended by the electrodeposit.

When the basis metal is polished or cold-worked in some form, so that there is marked breakdown of the crystals on the surface, extension of the large basis metal crystals cannot occur and deep etching must be employed to remove the broken-down crystals. Sub-surface effects of polishing[21, 22] extend, in some cases, to approximately .0005″ below the surface of the metal and these effects may be studied, in the case of copper, by deposition of copper upon polished copper which has been subjected to various degrees of etching attack. When this was done the crystals of the deposited copper immediately adjacent to the etched polished copper showed a progressive increase in size as the etching increased in severity until the cold-worked layer was completely removed. The depth of etching required is a function of the metal studied (particularly its hardness and tensile strength), the pressure used in polishing, and the size of the abrasive used in polishing.

When the polished basis metal is etched very little or not at all and copper is electrodeposited upon it, a layer of fine crystals

adjacent to the basis metal can be seen. Often very high magnifications (above 2500 X) is required to see these fine crystals. Attempts have been made to draw an analogy between these fine crystals and the layer of fine crystals observed next to the wall of the mold of chilled metals from the liquid state, but to the writer, the modus operandi of each phenomenon is entirely different. In the case of electrodeposition, the initially fine crystals are probably due, to some extent, to the tendency of the electrodeposited metal to follow the finely crystalline or amicrocrystalline condition of the polished and partially etched surface. Differences of electrochemical properties between the cathode and the deposited metal may also be contributing factors, although this condition is observed for copper deposited upon copper, and in this case, the differences in electrochemical properties should not be significant. The crystallization of the solid from the liquid state depends upon supercooling and the rate of transfer of heat through the liquid metal and the walls of the mold. The fine crystals of the solid formed adjacent to the relatively cool walls of the mold are due to the marked variation in these factors over the values present in the interior of the metal when it solidifies.

THE ROLE OF OXIDES

The adhesion of electrodeposited metals to oxide films is relatively weak even when the deposited metal is no further removed from the oxide than distances of the order of the lattice parameters for the basis metal. Oxide films also exert marked effects in preventing the extension of the crystals of the basis metal by the electrodeposit. Nickel oxide is partly responsible for the difficulty in obtaining extension of the basis nickel crystals by electrodeposited nickel. The interfering effects of oxide films are associated with three fundamental properties; namely, (1) the rate at which the oxide is formed, (2) the difficulty of removing the oxide by chemical means, and (3) the characteristic crystal structure of the oxide. The three properties are interrelated to a certain degree. Property (1) needs no comment other than that even with a high rate of oxide formation, this

property may not be serious unless the oxide is difficultly removed by chemical means. The oxide film need only be a few unit cells thick to exert complete masking effects and this is the case with chromium which oxidizes rapidly to form a relatively non-permeable oxide layer approximately 10 Angstrom units thick. Aluminum oxidizes so rapidly that all attempts to get extension of aluminum basis metal crystals by an electrodeposit have proved unsuccessful.

The oxides of chromium and nickel are removed with difficulty and frequently electrolytic pickling methods must be employed to remove these oxides. The low force of adhesion between an oxide and an electrodeposited metal is due to the intrinsic differences in their crystalline structures and more particularly due to the relative differences in atomic distances in the metal and in the oxide, and to the manner of the electronic arrangement between the atoms themselves. Mention has already been made of Hothersall's ability to get extension of the crystal structure of basis metals by electrodeposits of metals in the same crystal system having lattice parameter differences up to 12.5%. In many cases for a metal and its oxide, the differences between atomic distances in the pure metal and its oxide are well over 12.5%. For example, the a_o for face-centered cubic nickel[23] is 3.51 A, while the aô for cubic nickel oxide is 4.17 A. This means that if electrodeposited nickel were to follow the structure of nickel oxide, it would have to undergo over an 18% expansion in interatomic distances. This factor alone, however, would not account for the lack of adhesion because many oxides formed "in situ" have excellent adhesion to the mother metal. The inherent nature of the electronic arrangement of the atoms is the prime factor in consideration of our problem. Oxides of metals such as nickel, cobalt, manganese, and iron possess a cubic, sodium chloride type, crystal structure of an ionic nature[24] in which electrons are transferred from the outer shell of the metal to complete the outer shell of oxygen. The oxide is therefore one huge molecule with no individual molecules and the crystal lattice is bound together by the forces between the atoms thus ionized. When, upon electrolysis, a metallic lattice starts to form, there will only be a small cohesive force between

this lattice and that of the oxide because there will be few or no electrons available to form the normal metallic binding which has been postulated as being a mutual interaction of a "gas" of electrons.

INFLUENCE OF THE GEOMETRICAL STRUCTURE OF THE BASIS METAL

The orientation of individual crystals to expose favorable crystallographical planes to growth by the electrodeposited metal has already been discussed. The small-scale geometrical condition, that is, projections, holes or crevices of the order of .001″ to .005″ will have a marked influence upon the orientations of the crystals of the electrodeposit due to several reasons. The crystals of the electrodeposit tend to grow normal to the surface of the cathode in most cases; a notable exception is zinc deposited from an acid solution at a current density above 10 amperes per square foot.

The geometrical orientations will persist for considerable distances in the electrodeposit (.005″) if V_c is greater than N_c and such conditions have been observed to continue through 100 successive coatings of cadmium and nickel deposited in a barrel. In some cases, it has been observed by the writer that pits in the basis metal will induce the formation of nodules above the surface of the plate at that point due to the tendency of the normal crystal growth to persist and because there will be localized higher current densities at the edges of the pit.

Material remaining on the surface or projecting above the surface from differential solution may also cause changes in orientation of the crystals of the deposit at those points. Illustrations will be shown for graphite and iron-phosphide eutectic for cast iron and antimony for antimonial lead. Projecting impurities may influence the crystal structure by inhibiting diffusion of the plating solution thus increasing the amount of co-deposited basic matter.[25]

Examples will be presented where the large-scale geometry of the basis metal will be superimposed upon the small-scale effects of the projections and crevices previously mentioned, and the resulting structure will show orientation of the crystals toward

a common plane even though small sections may have an entirely different orientation. The intersection of two or more trends of crystal orientation will cause slight decrease in size of the crystals in the region of the planes of intersection. Other factors affecting the structure of electrodeposits such as the influence of colloidal films[26] and gas evolution must be recognized but they have not been included in this study.

The problems which we have considered have more than an academic interest. When the thicknesses of electrodeposits are small, these factors may not be significant, but for heavy coatings (over .001″), and such is the trend, a consideration of the effects of the cathode basis metal and the variables controlling the rate of crystal growth will enable the production of these deposits with a minimum amount of treeing, roughness, and variations in thickness. Many years have passed since Hogaboom postulated that the basis metal had an influence on the structure of the electrodeposit and although some skepticism was expressed as late as 1922[26], we can now share in the satisfaction of seeing those views completely substantiated by workers both at home and abroad.

DISCUSSION

CHAIRMAN HOGABOOM: I am sure we all enjoyed this wonderful talk by Mr. Meyer. The subject, of course, is peculiarly interesting to me and to have such a very fine demonstration of your opinions after twenty-two years is quite a compliment. The subject of "What is Under the Plate" is also apropos. Mr. Meyer has shown very clearly some of the things that cause trouble in electrodeposition, and some of the things that have been quite mystifying. I am quite certain you will agree that he has added greatly to the advance of electrodeposition of metal and that what he has done will stand for a long time as a most excellent work upon the structure of electrodeposits. His paper is now open for discussion.

MR. G. SODERCERG (Detroit, Michigan): I want to ask one question. You mentioned current densities all the way through — various current densities and current density limits. Do they refer to a given composition of plating solution, and so forth?

MR. MEYER: Mr. Soderberg's point is very well taken. Of course, any figures given for limiting current densities would necessarily refer to the type of solution used. If we used a higher copper sulphate content, a different acid content, or a different temperature, a variation in the limiting current densities would be obtained.

CHAIRMAN HOGABOOM: Is there further discussion? Surely this is not so overwhelming that we can't say something about it.

MR. THURBER: Just what preparation was made between the layers of deposits of the nickel especially?

MR. MEYER: I have not had much time to go into the various methods of preparation. The successive nickel coatings that you saw were formed on one of the conducting bars in the barrel nickel plating solution. Perhaps I didn't quite put that point over. The cadmium was taken from a button in a cadmium plating barrel. The nickel was taken from one of the danglers in a nickel plating barrel, and in some cases the samples were given to me by men who used a rod to stick in the plating tank to act as a dummy.

MR. THURBER: Then there is no special preparation except what you get right in the barrel.

MR. E. A. ANDERSON (New York City): I can not let this opportunity pass without expressing appreciation as one physical metallurgist to another. Plating is a problem in handling metals, and until we employ the facilities and knowledge of the physical metallurgist, we are passing up a splendid opportunity to enlarge our knowledge of plating.

We are dealing in plating with some rather remarkable forces. As Mr. Meyer pointed out, you can take a metal of one crystal structure and deposit on another of an entirely different crystal structure and alter it so that it follows the structure of the basis metal. There have been a great many studies made of the effect of working on metals, where metals have been worked until they have simply fragmented or fallen apart. They have not been able to destroy the fundamental crystal structure, and yet in the process of electrodeposition we can do it.

I want to point out one more thing and let Mr. Meyer think about it for a while. He was able to deposit hexagonal cadmium on cadmium and perpetuate the crystal structure. He was also

able to deposit hexagonal zinc on electrodeposited hexagonal zinc and perpetuate the structure. He was not able to do it on cast zinc. The physical metallurgist today believes that there is an essential difference between metals after they have gone through various stages of work. For instance, you can take a cast metal. You can anneal it and it will not change its grain size. You can work it and anneal it and it will change its grain size. You can anneal it until it has the same grain size it had when it was a casting, but it is not the same metal. I simply wanted to raise that one point, that the electrodeposited metal may be essentially and fundamentally different from the cast or the rolled metal.

MR. B. F. LEWIS (Detroit, Michigan): There is one question in the minds of all practical platers here. That is in connection with the electrodeposition of nickel over nickel, the first coating having been buffed and the surface, therefore, being more or less amorphous. I would like to ask Mr. Meyer if in his studies of the crystal structure of the electrodeposited metals he has observed any properties of cohesion of nickel over nickel under these conditions where the under coating is buffed and, therefore, is amorphous.

MR. MEYER: Back to the amorphous stage again! I mentioned in the text (probably it went by without being noticed) that nickel tends to form the rock-salt type of crystal structure of an ionic nature in which electrons are transferred from the metal to the oxide. We have an ionic condition, leaving no free electrons available for cohesion or adhesion. The oxide of nickel forms very readily and it is difficult to remove, as we all well know, and it has been possible to repair nickel coatings by a special technique. Our technique in depositing nickel upon nickel required a roughening of the surface and we haven't been successful in obtaining a successive nickel coating on nickel without roughening the surface and giving it some other special treatments.

In the photomicrographs which you saw, the successive nickel coatings did not have very good adhesion to each other. Those photomicrographs were shown to illustrate the perpetuation of geometrical structures rather than the perpetuation of crystal

structures. In cadmium, for instance, the crystal structure of cadmium was sub-microscopic, but we perpetuated geometrical structures. Tammann and M. Straumanis reported they were able to get extension of cadmium on cadmium, lead on lead, and zinc on zinc. I was able to get it with zinc on electrodeposited zinc, but I couldn't get it on cast zinc. I think Mr. Anderson's points are very well taken. The more you go on in metallurgy the more you find out that very small quantities of material will markedly alter the physical nature of the metal that you are studying.

Yesterday Dr. Blum mentioned a point that perhaps oxygen might interfere and oxygen does play a very important part in the structure of metals and their hardness and tensile strengths. Metallurgists are quite familiar with FeO age-hardening, in which you get the so-called stretcher strains or blue-brittleness and in those cases the FeO content is very small. With steel also you can get carbon age-hardening with only five hundredths of one per cent of carbon.

CHAIRMAN HOGABOOM: Is there further discussion?

MR. WOOD: I want to make an observation on two micrographs that Mr. Meyer showed in his very fine talk. One of them I believe he said was done by Hothersall on one per cent brass, and in that the structure of the deposited copper showed a definite columnar structure; that is, the reproduction or the continuation of the base metal crystals, the boundaries between the crystals, were perpendicular to the surface of the basis metal. In the other photomicrograph, I believe one of Dr. Blum's, in which copper was deposited over copper, in that case cast copper, I believe, the reproducing crystals were actual continuations of the basis metal crystals, and apparently the orientation of the crystal units was a definite continuation of the orientation in the basis metal crystals. I think it is possible that there are two different types of continuation, and that a further examination of those two photomicrographs might be of interest.

MR. MEYER: The type of continuation that you get depends a good deal on the current density and on the size of the crystals, and I showed in another slide that you might get extension for a short distance and then the crystals are unoriented. The curving

of the grain boundaries is what I believe Mr. Wood is referring to in Dr. Blum's photomicrograph. The columnar crystals that you saw in my photomicrograph, particularly, were way above the surface of the metal, and above the surface of the metal you begin to obtain the straight crystal boundaries. But little differences in operating conditions will cause variations in the type of continuation, although the continuation fundamentally is the same.

MR. WOOD: I am afraid I didn't make myself clear. The photomicrograph that I wanted to compare with Dr. Blum's was the one by Hothersall on one per cent brass, I believe you said, and, if you recall, the crystal boundaries in the deposit were definitely perpendicular to the basis metal, suggesting that the orientive forces are not the same in both cases.

MR. MEYER: I can't agree with the point that you have taken. I think what should be done is a study of the sides of the grain boundaries, and I will be glad to go over that with Mr. Wood after this discussion so we won't prolong it.

MR. MESLE: I don't want to let this opportunity go by without saying something, since Mr. Hogaboom and I have apparently had differences of opinion on this question, and I am sure we appreciate Mr. Meyer's work on this. Our difference has been this: George has said that the plating may follow the crystal structure. I have said that was not necessarily so, and I think Mr. Meyer has confirmed what George has contended over the years, and also has confirmed my contention, which is that by manipulating your current or other factors, your deposit does not necessarily need to follow the structure of the base. So at least we are agreed on that point.

MR. J. M. COSGROVE (Columbus, Indiana): Perhaps we can correlate this paper with corrosion resistance. May I ask Mr. Meyer to make it clearer as to just why a better polished piece would probably stand better. Here is a picture showing a scratch where these grains grew and formed quite a wide opening clear down into the work. That would lead us to believe, wouldn't it, that probably it would have better corrosion resistance?

CHAIRMAN HOGABOOM: Is there any further discussion? I am sure we are greatly indebted to all those who took part in this discussion and to Mr. Meyer for his very excellent paper.

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The Silver Jubilee and the Spirit of the Founder

In June of this year, in the great city of New York, there will be a gathering of hundreds of men and women, delegates and friends from every state in the Union. They will be motivated by a common purpose. The celebration during four eventful days of the Silver Jubilee of the American Electro-Platers' Society — its 25th Annual Convention.

There are many conventions, of all kinds, held yearly, in this great land of ours. Is this then just another Convention? Are the delegates and visitors, business men interested purely in the economic aspect of an industry?

Perhaps! Nevertheless, there is deeper significance underlying this convention, as well as past A. E. S. Conventions.

It has a spiritual quality; a kindredness of spirit, manifest in all fields of science, that finds its noblest expression in the generous interchange of ideas.

The great majority of men at A. E. S. Conventions are the enthusiastic votaries of an applied Science. There is about them the soul of the Guild Spirit — pride in workmanship, skill, and knowledge.

Herein lies the deeper significance!

In the light of this spirit and enthusiasm one can understand Charles H. Proctor. In a material and uncertain world, his idealism is refreshing and stimulating.

All of us appreciate the value of the various awards for the best papers submitted to Branch Meetings and Conventions. Nevertheless, there is something about the Herminiea Dorothea Proctor Award for the best paper submitted at this and future conventions, that warms and touches our hearts. Not on account of its intrinsic value, but because here is a living monument to the sincerity of a man and his work. By this award, Mr. Proctor indicates an affection for the Society he founded second only to the feeling for the dear companion of his adult life. The A. E. S. is fortunate indeed in its founder and its friends.

The Silver Jubilee, therefore, is no ordinary commemoration of a quarter of a century of time. It celebrates a span of time in the existence of a society, characterized by the essential qualities of the Guild and scientific spirit.

It is in this spirit too, that we ask you to send in your papers for the Educational Program of the Convention to Mr. John Rolf, Chairman of the Educational Committee as soon as possible. Both Branch and individual papers will be given most careful and impartial consideration.

The Biblical reminder "man does not live by bread alone" is testimony of the keen psychological insight of the ancients. Enthusiasm and love for our work, sweetens the daily bread of existence. This, in the final analysis, is the spirit of A. E. S. Conventions.

THE CONVENTION COMMITTEE,

Louis H. Cates, *Publicity Chairman*

COMMITTEE ON PRIZE AWARDS FOR PAPERS

President E. Steen Thompson has appointed the following members to serve on the above committee, all of whom have agreed: DR. WM. BLUM, Bureau of Standards Chairman; WALTER R. MEYER, Bridgeport Branch; AUSTIN FLETCHER, Binghamton Branch; C. E. CLINDININ, Chicago Branch; WM. J. R. KENNEDY, Springfield Branch.

The Silver Jubilee at New York

In June of this year the American Electro-Platers' Society will hold their twenty-fifth annual Convention and Educational Program in the City of New York, the city in which it had its beginning, the cradle, so to speak, of the A.E.S., where, in the year 1913, a small group of intrepid men, inbued with the pioneering spirit, set about the task of making nation wide a movement that had sprung up in some of the larger centers along the Atlantic Seaboard, a movement that gained impetus and spread rapidly in the years to follow and that has progressed so greatly that today the Society enjoys a comparable position among the Scientific and Educational Societies of the Americas and has been accorded international recognition, as is made evident by the invitation to some of its prominent members to take part in the deliberations and presentations of the first International Electro-Deposition Conference to be held in London, England, in March of this year.

When the Society convened for its 24th annual meeting at Cleveland, Ohio, in June of last year the delegates thereto extended a signal honor to the New York Branch (the Mother Branch) when they designated New York as the 1937 Convention City and entrusted to the Branch the task of promoting the 25th annual Convention, the Silver Jubilee of the Society, an honor which New York Branch sincerely appreciates and takes pride in its bestowal. In consequence with the honor, there is present a responsibility of like nature. We in New York will try to assume that responsibility and to carry on to a happy conclusion a successful Convention. As chairman of the New York Convention Committee I would like to take the opportunity at this time accorded me through the pages of our MONTHLY REVIEW to ask for the co-operation of the membership at large, our friends and well wishers among the technical men and supply organizations, who, in the past, have manifested their good will and intentions by giving such to the end that the aforementioned result may be had. These two particular features of the Convention in which this request could be especially heeded, that of the Educational session which in a sense is the most important part of the program. A wholehearted response on the part of the Branches and individual foreman platers thereof will assure success for the practical papers feature of the Educational Program, such feature to take up one entire day of the sessions, and a like response from our technical friends approached by Mr. John Rolff, the chairman of the Educational Program Committee, will suffice for

results in this direction. If those able and willing to present papers at this Convention will signify their intention of doing so to Mr. Rolff and wherever possible give the title of same and the approximate time required for its presentation it will expedite the formation of the program to an early date and enable him to complete his work in due time.

The second feature of importance is the matter of individual and Branch exhibits of plated wares and manufacturers' plated products, which up to now not much has been said or done about. This feature should not be neglected inasmuch as a large and good looking display of plated products creates a genuine interest for visitors and registrants at the Convention and the rank and file of the platers themselves. If those members, Branches and manufacturers desirous of information relative to this feature of the Convention will communicate with Mr. Ralph Ligouri of 2429 Hubbard Street, Brooklyn, N. Y., Chairman of the General Program Committee, who has charge of exhibits, they will get the required information. I trust a splendid showing will be made in this connection. A word might be said relative to the work of the Publicity Committee of which Mr. Louis Cates is Chairman. Those interested in offering suggestions and recommendations connected with the publicising of any feature of the Convention might communicate with him c/o the Enequist Chemical Co., 255 Freeman St., Brooklyn, N. Y. They will find him receptive to ideas.

In conclusion we in New York hope to have the largest gathering ever assembled at an A.E.S. National Convention. In anticipation of such we aspire to provide as pleasant a stay and as fine an entertainment program as befits the occasion of the Silver Jubilee and as circumstances will present. With your co-operation and support we hope to and will try to accomplish that which you expect of us.

Very sincerely,

FRANKLYN J. MACSTOKER,

General Chairman, N. Y. Convention Committee

Supplementing Mr. MacStoker's letter we might add that the Society is really 28 years old, being organized in 1909 as the National Electroplaters' Society, a New York City organization, to which all members belonged until the forming of the American Electro-Platers' Society in 1913. This year, therefore, we celebrate the Silver Jubilee of the A. E. S. as stated in Mr. MacStoker's letter.—*Editor.*

Here and There

New York Branch held its regular meeting on Friday, January 8th, at the Pennsylvania Hotel. There was a good attendance, and a fine spirit of helpfulness and cooperation prevailed.

One of the important topics discussed was the papers by foremen platers. In spite of all that has been said there is, as in the past a great reluctance on the part of foremen to present an article on practical plating as individuals. We have been criticised somewhat severely in the last few years because the practical plater has not had a chance to assert himself. However when it comes to presenting papers or entering into the discussions, the great majority of our members seem to let the others do the talking, and criticize the convention committees afterwards because the practical plater has been ignored.

There is a great incentive given to those presenting papers this year, in the one hundred dollars award given by our Founder, Mr. C. H. Proctor. This in addition to the gold medal awards and the strong request by the Committee should create an enthusiasm among our members that will result in a generous response, in producing papers of real value by our foremen platers.

The Branch meeting was well conducted. President Liguori makes an ideal chairman; there are no interruptions while he is in the chair. We hope he has the privilege of presiding at one of the Educational Sessions of the Convention. There will be no back seat chatter to disturb the speaker if he knows it.

Secretary MacStoker told us that there are no "yes" men in N. Y. Branch. Well, we found out what he meant during the discussion that followed the address. Every member expressed himself freely, and through it all there was not an unpleasant word spoken. No one could have been more courteously treated, no one could have been shown more genuine hospitality than the N. Y. Branch members showed during our visit. It was a pleasure to meet the members, many of whom we have heard about. We missed seeing past president John Sterling. Mr. Sterling has been indisposed for several weeks. We hope for his speedy and complete recovery very soon.

The meeting with the various committee chairmen broke up about 1 a.m. We left these men with a stonger determination than ever to give them our earnest cooperation. They are sincere in their endeavors regarding every detail of the convention and merit the support of every member of the A.E.S. Let's give them papers, technical and practical. By doing this we will arrive at the New York Convention in pleasant anticipation and leave with an expression of satisfaction with a job well done.

Thanks! Messrs. MacStoker and Liguori; we hope to be with you again—soon.

On Friday Evening, January 15, we had the pleasure of attending Providence Branch meeting. There was a good attendance and some fine discussions regarding the A. E. S. Everyone present seemed to be interested in putting Providence Branch back on the map again.

This section of New England has a great many platers that could be induced to join our organization. Some of the older members told us that Providence used to be one of the largest branches years ago, having over one hundred members. Why not start building again? Here are some encouraging features to begin with. You have all your dues paid up-to-date. You have a wonderful past history and two officers in Messrs. Chace and Andrews that are willing to work. Your meeting place at the Narragansett Hotel is ideal. You also have in addition to your officers, men like Mr. Tyndall, Mr. Garrick, Mr. Cahill, and several other prominent men in the industry who would be glad to help in a membership drive. Then again we felt quite confident that such men as Mr. George Hogaboom, Dr. Blum, Mr. Oliver Sizelove, Mr. Phillips, and others would be willing to help, by addressing your meetings

from time to time. Let's get started, and make a special appeal to the younger men who need the educational assistance that the A.E.S. stands for.

Bill Cahill gave a good talk on cleaners at the meeting. Everyone likes Bill, he's a good booster for the Branch. All Providence needs is somebody to start the ball rolling then watch it pick up speed.

The members were all sorry to hear about George Hogaboom's illness and wish him a speedy and complete recovery.

We would like to have seen Mr. Tyndall, but he has been "under the weather" for several weeks; he sent a good representation however in Messrs. Garrick, MacDonald, and Murphy. Mr. Tyndall's influence in the Providence-Attleboro plating industry is an enviable one; we have heard many nice things said about him.

Don Wood of Reed & Barton's brought a delegation from Boston with him to the meeting and invited all to the big time in "the Hub" March 6. All roads lead to Boston on that day for the platers.

The whole membership is interested in results at Providence. We are all with you boys and we pledge you our hearty cooperation as you plan to make 1937 one of the best years in your history.

ANNOUNCEMENT

Atlas Powder Company announces the acquisition of "Revolite", formerly manufactured by the Revolite Corporation, a subsidiary of Johnson & Johnson, New Brunswick, New Jersey.

The manufacture of "Revolite" will be moved to Stamford, Connecticut, where the business will be conducted by the Zapon Division, Atlas Powder Company. Mr. M. J. Creighton, General Manager of the Zapon Division, will direct the new enterprise.

"Revolite" is the registered trade name of a fabric coated with a flexible Bakelite resinoid. "Revolite" presents remarkable qualities of beauty and utility, and is made in a wide variety of metallic finishes and striking colors. "Revolite" is well-known in the interior decoration and upholstery fields. The extreme durability and permanence of this Bakelite resinoid-coated material should make it applicable to many industrial uses where its high resistance to heat, alcohol, soaps, oils, and chemicals provides properties not obtainable in the older types of coated fabrics.

"Revolite" fits in with the long-established line of Zapon pyroxylin and rubber coated fabrics, to broaden and extend the activities of the Company. Atlas will continue research and development in order to augment and improve the possibilities of this versatile material.

Atlas is taking over Revolite personnel in both Sales and Manufacture. Mr. Gustav Gurska is General Sales Manager of Zapon Coated Fabrics. Mr. William A. Mitchie, who has been associated with the Revolite Corporation, will be in immediate charge of Revolite sales.

T. C. EICHSTAEDT APPOINTED TO SUCCEED THE LATE MR. SHEEHAN AS CHAIRMAN OF THE MEMBERSHIP COMMITTEE

To the Delegates of the Supreme Society, Branch Secretaries, and Chairmen of Branch Membership Committees,

Greetings:

In accord with the power invested in me as outlined by the last portion of Sec. 1, Art. IV of Part I of our Constitution, I have appointed Mr. T. C. Eichstaedt, Secretary of the Detroit Branch, to fill out the balance of the term of office left vacant by the death of Mr. P. J. Sheehan.

Mr. Eichstaedt, in his efforts to increase Detroit's membership, his faithful discharge of all duties imposed on him at past Conventions, and his insight into all matters pertaining to the welfare of the Society has created an impression which will substantiate the logic of his appointment.

We hope that the entire membership will get back of Mr. Eichstaedt in his new undertaking and carry out without delay any and all requests he may make relative to the Membership Drive.

Since the Society mourns the loss of Mr. Sheehan, I can think of no more fitting memorial to his name than to have the work he inaugurated, as Chairman of the Membership Drive, go forward with increasing impetus under the guidance of his successor.

Fraternally yours,

E. STEEN THOMPSON,

President.

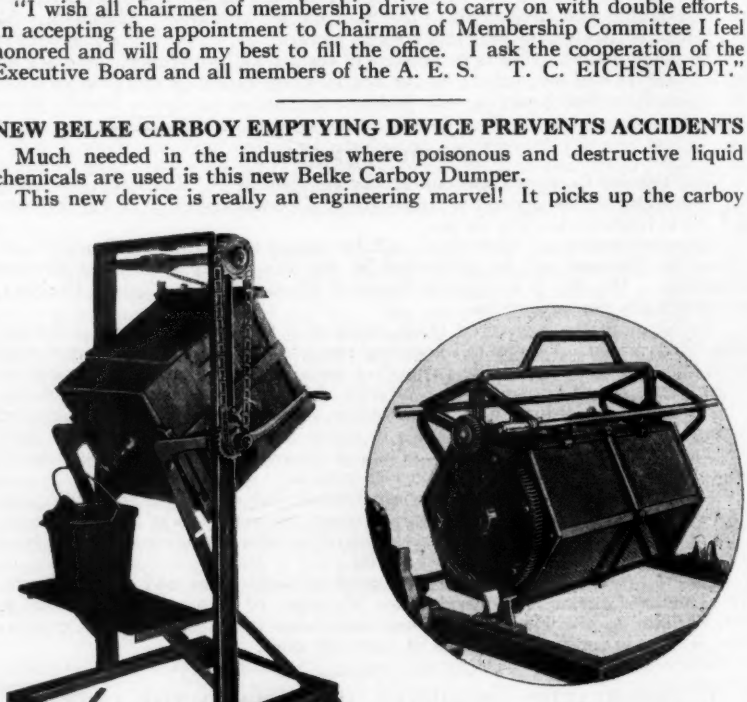
The following telegram has been received from Mr. Eichstaedt:

"I wish all chairmen of membership drive to carry on with double efforts. In accepting the appointment to Chairman of Membership Committee I feel honored and will do my best to fill the office. I ask the cooperation of the Executive Board and all members of the A. E. S. T. C. EICHSTAEDT."

NEW BELKE CARBOY EMPTYING DEVICE PREVENTS ACCIDENTS

Much needed in the industries where poisonous and destructive liquid chemicals are used is this new Belke Carboy Dumper.

This new device is really an engineering marvel! It picks up the carboy



and empties it completely without losing a single drop of acid or changing the position of the bucket.

This is accomplished by two centers of rotation which enables the pouring stream to take place in a single spot.

The operator is always at a safe distance from the bucket and is consequently protected from dangerous acid burns or blinding ammonia fumes.

One of the important features of this device is that it is mounted on rollers and can be quickly rolled out of the way when not in use.

Besides being a precautionary measure against accidents the Belke Carboy Dumper saves labor. One man can easily pour out the necessary quantity of acid without the usually necessary additional helper.

NEW BELKE SMALL LOT PLATING BARREL MOST HANDY THING IN PLANT

The development of this handy, new piece of equipment by the Belke Manufacturing Company of 947 N. Cicero Avenue, Chicago, Illinois, now enables plating plants to do small lot work at a profit. The money-saving features of these small-lot barrels are apparent. They are used in your still tanks, utilizing present solutions and anodes, eliminating the expense of making new solutions for each batch of work, and buying new anodes. They do away with the bother of handling and watching baskets. They have all the high efficiency of large mechanical plating barrels and do better work than can be accomplished by still plating.

This small-lot plating barrel is made of a new caustic resisting bakelite developed by Belke Engineers and will stand up under any kind of plating, even in high temperature solutions. By placing one on a small plating tank you have a complete mechanical plating unit.

Barrel is Light!

One of the important features of this Small-Lot Plater is that the barrel is very light. The motor is mounted on a specially designed frame instead of to the barrel. This eliminates the necessity of lifting the motor with the barrel.

Solid, Continuous Cathode Contact Eliminates Treeing!

Like the larger Belke units this small lot barrel has the continuous cathode conductor that is heavily insulated with a layer upon layer of rubber from the bus bar to the contact knob. The cathode contact cables, which are on each end of the barrel are constructed of heavy, flexible copper wire, the bodies of which are thickly insulated and have heavy chromium plated steel knobs, on the ends. These press down on the work to provide good contact and uniform current distribution. This exclusive Belke feature eliminates dangler and prevents treeing around open contacts and absorbtion of metal in the solution; thereby speeding up plating.

For further precaution against shortage the motor take off gear in this unit is made of laminated bakelite to prevent current from passing from motor to the large driving gear on the barrel.

Rigid Construction Throughout!

The hangars like those on larger Belke units are bolted securely to the supporting bar and eliminate any possibility of weaving. The barrel therefore, always remains in perfect alignment.

A rubber insulated steel band encircles the center of the barrel to prevent the ribs from warping under the most severe conditions. This insures longer life and maximum service.

Replaceable Bushings on Hanger and Barrel Flanges

A new and important development in barrel construction are the easily replaceable bushings in the hanger where the small driving gears rotate. This enables a speedy and economical replacement of only bushings instead of the entire hanger construction as is usually necessary. Bushings are also used in the barrel flanges where the wheel rotates on the hanger axel. When the bushings wears out, you merely replace it instead of the entire flange.

Belke Rib Construction Gives Extra Strength

The barrel walls are fitted into the barrel ribs on an angle for greater strength and more support. The cylinder itself is made of Belke non-warping impregnated bakelite. The cover panel is designed with Belke Rubber covered spring clamps which make loading and unloading a matter of only a few seconds.

Belke Small Lot Plating Barrels are made in two sizes and are easily handled and platers say that they are indispensible units to have around the shop.

FLEXOGRIP

Few companies realize that their efforts to keep polishing wheel maintenance costs at a minimum are defeated by their use of ordinary cement or glue as an adhesive.

Polishers all over the country whose production schedules permit no "bottleneck" due to undependable wheel "set-up" have demanded a better polishing wheel adhesive.

They now have it in "FLEXOGRIP"— Udylite's latest contribution to better polishing. Intensive development work in the Udylite laboratories supplemented by a year of thorough and diversified usage in the Field have produced this vastly improved polishing wheel bond — one that is far ahead of anything else.

The advantages of Flexogrip over other cements and glue are many. For example here are a few that taken alone are sufficient reason for further investigation of its merits.

FLEXOGRIP DOES NOT CHIP OR BREAK OFF — becomes integral part of wheel and grain. Results: gives longer wheel "head" life.

FLEXOGRIP REQUIRES NO THINNER — is applied as received. Extremely low surface tension and high penetrating qualities permit it to seep not only into the fibres of wheel or belt material, but into the pores of abrasive grains as well — *Result*: perfect affinity between wheel or belt and abrasive grain.

FLEXOGRIP UNLIKE ORDINARY CEMENT OR GLUE HARDENS RAPIDLY UNDER HEAT — this makes it possible when necessary to force dry wheels and speed up the wheel setting up operations. But more important still — friction heat generated in operation causes Flexogrip to become brittle and fracture into small areas when the wheel runs and comes in contact with the work. Fresh cutting edges of the grain are in this manner exposed to the work. Naturally, faster as well as more open cutting results.

A FLEXOGRIP SET-UP WHEEL HAS LESS TENDENCY TO CROWD OR FILL UP when polishing soft metals. *Result*: a longer wheel head life and less change of ridging or greying the work.

FLEXOGRIP MINIMIZES WHEEL GLAZE AND PREVENTS WHEEL BURNS — glue softens under heat allowing grain to sink in and eventually glue instead of grain comes in contact with the work. *Result*: streaking and discoloration of work not obtained when Flexogrip is used.

FLEXOGRIP MINIMIZES POLISHING WHEEL SET-UP TIME. It eliminates glue pots, the soaking and cooking of glue and heating of grain.

Flexogrip not only extends the life of the polishing wheel but it eliminates the necessity of carrying an overlarge stock of extra wheels, thus maximum production is obtained with a minimum amount of wheels.

Flexogrip is furnished in two types. Type A—specially formulated for grains coarser than No. 80. Type B—holds perfectly abrasive grains finer than No. 80 up to and including FF grade abrasives.

Flexogrip is shipped in standard steel sealed containers in 25, 50 and 100 lb. lotsfrom Detroit, Michigan. Inquiries may be addressed to any one of the Udylite Company Branch offices in New York City, Chicago, Cleveland, or San Francisco or direct to Main Office of the Udylite Company at 1651 East Grand Blvd., Detroit, Michigan.

The Abstract Section

JAMES W. HANLON, *Chairman, Program and Educational Committee*

The Rectification of Faulty Acid Copper Solutions. E. A. OLLARD, *J. Electrodepositors' Tech. Soc.* **12,** preprint, (1936)—The causes and remedies of the principal difficulties encountered in producing thick copper deposits from acid baths are summarized as follows. (1) If the copper is too soft, there may be insufficient acid or too high a temperature. Any other, undetermined, cause of softness may be corrected by adding phenolsulphonic acid equivalent to 0.5 g/l of phenol. (2) If the copper is too hard, it is usually caused by an excessive amount of some colloid, such as glue (from emery cloth dropped in) or resin (from wood tanks). Oxidation by permanganate is difficult to apply. In some cases, treatment with sulphurous acid, followed by electrolysis with a lead anode, removed the cause of the trouble. (3) If the copper is rough, this is usually caused by suspended matter, that can be removed by filtration. (4) Very brittle copper deposits are produced by organic impurities, too high a current density or too low acidity. W. BLUM.

The Production of Black Anodic Coatings on Tin and Tin Alloys. R. KERR and D. J. MacNAUGHATAN. *J. Electrodepositors' Tech. Soc.* **12,** preprint (1936)—The solution is prepared from 100 g/l (13 oz/gal) of disodium phosphate ($Na_2HPO_4.12H_2O$) and 20 ml/l (2.6 fl. oz/U. S. gal) of phosphoric acid (sp.g. 1.175). (ABSTRACTOR'S NOTE—This solution is approximately equivalent to a solution containing 72 g/l (9.5 oz/gal) of anhydrous monosodium phosphate, NaH_2PO_4; with a small amount of phosphoric acid to produce the desired pH of 3). When tin, tin-coated articles, or high-tin alloys (such as pewter) are made anodic in such a solution at 90°C (194°F) and at 30 to 40 amp/ft^2, a blue-black film is produced on the surface. Copper cathodes are employed, and should be removed when the bath is not in use. The film is principally stannic oxide, SnO_2, and is about 0.0001 inch thick. By suitable insulation of portions of the surface, black designs may be produced on a bright tin background. W. BLUM.

The Electrodeposition and Properties of Black Lead Peroxide Coatings. S. G. CLARKE, *J. Electrodepositors' Tech. Soc.* **12,** preprint (1936)—The bath contains 120 g/l (16 oz/gal) of sodium hydroxide, NaOH; and 40 g/l (5.3 oz/gal) of litharge, PbO. The metal to be coated is made the anode at a current density of 1 to 30 amp/ft^2, in the above bath at 40 to 50°C (104 to 122°F). Cathodes of lead, iron, or nickel may be used, preferably surrounded by porous pots. Smooth, lustrous black deposits are produced in from 1 to 1.5 hours. The throwing power is good. No addition agents were found beneficial. The deposit is hard and resistant to abrasion. Its adherence is poor on polished metals, but good on roughened surfaces, or on unbuffed plated surfaces, for example of copper and nickel. It should be protected by

oil to prevent white stains under outdoor conditions. Coatings 0.0005 inch or more in thickness are nearly impervious, but permit corrosion of the base metal if the coating is penetrated by abrasion. W. BLUM.

Black Chromium. E. A. OLLARD, *J, Electrodepositors' Tech. Soc.* **12,** preprint, (1936)—A solution containing 250 g/l (33 oz/gal) of chromic acid and *no* sulphate, yields a black deposit at or below room temperature at very high current densities such as are produced with 12 to 16 volts. The coating is not very adherent, and has relatively little practical value. W. BLUM.

The Control of Chromium Plating Solutions. A. A. PEARSON, *J. Electrodepositors' Tech. Soc.* **12,** (preprint), (1936)—The daily addition of 2.5 oz. of chromic acid for each 1000 ampere hours passed through the bath is recommended to make up for the chromium actually deposited. If then the solution is brought to the normal level, and its specific gravity adjusted to normal by addition of chromic acid and sulphate in the initial ratio, the bath may be kept approximately constant. Occasional analyses are required to make up for effects of iron and trivalent chromium on the specific gravity. Tests of throwing power with a cavity scale or bent cathode are also useful. The iodometric titration of the chromic acid is preferred to the ferrous sulphate-permanganate. The gravimetric determination of sulphate is most accurate, but the centrifuge method of Kocour give results that agree fairly well with the gravimetric. Iron and trivalent chromium can be reliably determined only by the rather involved method described by Blum and Hogaboom. W. BLUM.

Electrodeposition of Manganese Using Insoluble Anodes. C. G. FINK and M. KOLODNEY. *Trans. Electrochem. Soc.* **71,** preprint, (April, 1937)—Good deposits of manganese were obtained from a solution containing 100 to 200 g/l (13 to 27 oz/gal) of manganous sulphate, $MnSO_4.4H_2O$, 50 g/l (6.7 oz/gal) of ammonium sulphate, $(NH_4)_2SO_4$, and 50 m/l (6.4 fl.oz/gal) of glycerol, $C_3H_5(OH_3)$. The pH was 2.5 to 3, the temperature about 25°C (77°F) and the current density was 10 to 12 amp/dm^2 (93 to 116 amp./ft^2). Graphite anodes were used within porous pots. The deposit is hard, white and lustrous, but rapidly oxidizes in the air unless it is dipped into a dilute chromate solution immediately after deposition. Preliminary tests indicated that alloys of iron and manganese, or of zinc and manganese, can be deposited from suitable mixed baths. W. BLUM.

Obituary

PETER A. PINSONEAULT of Oakite Products, Inc., died December 26th after an illness of a few days.

As service and sales representative for twelve years with the above company, he had gained a wide acquaintance among the industrial plants in the territory he covered.

Mr. Pinsoneault was with the Chicago Pneumatic Tool Company for fourteen years previous to his connection with the Oakite organization.

To the great number of friends who held him in high esteem and affectionate regard, his sudden death caused profound sorrow and regret.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTRO-PLATERS' SOCIETY

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held January 9, 1937, at the Atlantic Hotel.

President G. Jelinek presided and all other Officers were present.

Mr. C. Clindinin, chairman of the membership committee, reported progress and called on every member of Chicago Branch to become a member of this committee and assist his fellow platers by getting them to join our Society.

Mr. H. Smallman reported the sudden death of our National First Vice-President, Mr. P. Sheehan of Milwaukee, Wis. Chicago Branch Officers and Members wish to express their deepest sympathy to the family of Mr. Sheehan.

Mr. C. S. Tompkins read a very interesting report on what the Research Dept. was doing, and urged all members to get their firms to become a part of this most necessary work.

The librarian, Mr. Servis, found the following questions in the question box.

1. *What is the best metal to use to build a salt spray box—Monel or stainless steel?*

Ans. Steel and it should be glass lined.

2. *What causes a white film on anodes in a cyanide copper solution? It comes off easily when it is brushed.*

Ans. Lack of cyanide, too high a carbonate content. One member stated that when too much Bi-sulphite of soda had been used in a cyanide solution this causes a white film to appear on the anodes.

3. *An electric cleaner is used in cleaning brass parts that have been soldered together; a smut forms on and around the solder. How can this be removed?*

Ans. A 4 or 6 oz to the gal of cyanide solution with reverse current will remove this smut.

4. *What is the Watts Nickel solution? How is it made?*

Ans. 4 to 6 oz Chloride, 4 oz Boric Acid, 32 oz. Single Nickel per gal. used hot from 105% to 125%.

5. *Is there any rust resisting liquid that can be used on bright steel, such as knife blades or forks that will prevent the rusting of articles when displayed in stores on counters?*

Ans. Several suggestions offered—lacquer, oil, also phosphoric acid dissolved in alcohol and brushed on.

The 25th Annual Banquet and Educational meeting was held Saturday, January 16, 1937 at The Palmer House. The following papers were read and discussed: "A Review of Plating on Radiator Shells," by Dr. O. P. Watts, Wisconsin University, and an Honorary member of Chicago Branch; "Some Actions and Reactions Found in Low pH Nickel Solutions," by Lester Borchert, General Spring & Bumper Corp.; "Colored Photography as Applied to Plating Research," by W. M. Phillips, General Motors Corp., a member of Detroit Branch and also Research Chairman of A. E. S.; "What Does the Ammeter Tell Us?", by George B. Hogaboom, Hanson-Van Winkle-Munning Co., member of Newark Branch and Past President of A. E. S.

This session was well attended, there being present 350 foremen electroplaters, their assistants and superintendents. The speakers were all well received and the talks much appreciated. Dr. Watts presented Chicago Branch a bound volume of his works and Chicago Branch had the pleasure of presenting Dr. Watts with a desk pen set as a token of their love and esteem for him, and inadvertently neither knew the intentions of the other and both were surprised and much appreciative.

Our librarian, Mr. O. E. Servis, past president A.E.S. presided with his usual efficiency and sparkling wit and humor which add much to these sessions and make them well worth attending.

The banquet part of the program was one of a sparkling nature; the Grand Ball Room of the Palmer House was done up in fitting style. The dinner was excellent and the orchestra grand, the floor show the best we have had. There were 624 people who ate dinner and the dancing continued from 7:30 p.m. to 1 a.m.

About 25 people from Milwaukee were there, Detroit several, Newark about four, New York three, St. Louis several, and a few from Anderson. So it kind of looked like a National Convention.

There was much visiting between sessions and a lot after the dance. The correspondent saw several in the hotel lobby at 5 a.m. looking for a breakfast place, so it must have been a success.

J. W. HANLON, *Sec.*

NEWARK BRANCH

The regular meeting of the Newark Branch A. E. S. was held on Friday evening, Dec. 18, at the Kreuger Club, Springfield and Belmont Ave., Newark, N. J. The meeting was called to order at 8:45 p.m., President Sam Taylor presiding.

The following officers were present: Sam Taylor, president; John Kotches, vice-president; George Wagner, secretary; Nelson Sievering, treasurer; Paul Oldam, librarian; George Klink, Sargeant-at-Arms; and William Hodecker, Trustee. The minutes of the previous meeting were read and approved.

An application for Mr. Jack Shamis was received and voted on to take the regular course. Andrew Muller, 959 Bergen St., Newark, N. J., was reinstated for membership.

The question of the 1939 convention was brought up again and Mr. Horace Smith stated some of the Connecticut members were taking a trip to England shortly and they would like to know if it would be definitely decided that the 1939 Convention would be international, if the Newark Branch could get it. All the members of the Newark Branch were in favor of making it international.

Our Librarian, Mr. Oldam, brought up the subject of the paper on gold plating to be presented at the New York convention and it was decided that this paper should be accompanied by an exhibit and he asked every member who was doing gold plating to make a special effort to get some suitable articles for the exhibit. This being another one of Newark's social nights the meeting adjourned early and was followed by refreshments, old Franklin Street Style. The boys departed about midnight.

The Librarian of Newark Branch, Mr. Paul Oldam, announces that Dr. Blum, Bureau of Standards, will be the speaker at their meeting on Feb. 19. His subject will be "Methods of Testing Electro-plated Coatings."

The Newark Branch A. E. S. held its regular meeting on January 15, 1937, at the Kreuger Club, Belmont and Springfield Ave., Newark, N. J. The meeting was called to order at 8:30 p.m., President Sam Taylor presiding. All officers were present. The minutes of the previous meeting were read and approved. Mr. Treadwell was reinstated to membership of Newark Branch as an associate member. It was decided by a majority vote that the annual banquet of Newark Branch should be held on April 10, 1937, at the Hotel Douglas, Hill St., Newark, N. J.

The secretary was instructed to write to all the branches of the A. E. S. asking their support for the 1939 Convention to be held in Newark. Also write to the Supreme President for consent to make this convention international.

Mr. Oldam, librarian, received some very good answers to his request for data on gold plating, all of which will be given out at the New York Convention. Mr. Oldam stated that the speaker for our February 19th meeting would be Dr. Blum of the Bureau of Standards and that his subject would be, "The Method of Testing Electroplated Coatings." The meeting adjourned at 11 p.m.

GEORGE WAGNER, *Sec.*

MILWAUKEE BRANCH

The Milwaukee Branch A. E. S. held its regular meeting January 14, 1937.

Vice-President Henry Bender was in the chair in the absence of the President. Minutes of the last regular meeting were approved as read.

A motion was made and seconded that the application of Mr. Claude Terrill, Milwaukee, and Mr. Ralph Paddock, Manitowoc, take their regular course.

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The dinner dance which was to be held late in January or early in February has been cancelled, but our educational meeting and smoker will be held sometime in April.

A motion was made and seconded that the resignation of Roman Binder, Secretary-Treasurer, be accepted. Mr. Al Hermansen was elected the new Secretary-Treasurer. Good luck, Al.

It is with deep regret we have to write that Milwaukee Branch lost the "Dean" of platers in this territory, Mr. Pat J. Sheehan, 1st Vice-President of the Supreme Society, who died January 9, 1937. His dynamic personality—that spirit of live and let live—his very deep interest in the Society, his knowledge of the plating game which was at the disposal of anyone who asked for it, will be greatly missed. Mil-

waukee Branch will always feel the loss of Pat J. Sheehan as long as memory serves us.

ROMAN C. BINDER,
Sec.-Treas.

WATERBURY BRANCH

Engineers Hall was comfortably filled Friday evening, January 8th, the occasion being the regular meeting of Waterbury Branch A. E. S. Members and friends came prepared to spend an interesting evening, listening to our old friend George B. Hogaboom, deliver one of his forceful talks on plating matters. It was with regret that President Tennant Elwin informed the meeting, that the genial George would not be present, due to an illness, occurring a few days previously. Those present were naturally disappointed but the feeling was somewhat alleviated when it was announced that Bryan Hogaboom would substitute in his father's place. Taking for his subject "Pitting" the speaker gave a very able talk on this important topic. Many new points on this "plague of the plater" were brought out and all voted the talk an interesting presentation. A rising vote of thanks was extended the speaker, and the secretary instructed to write and convey the wishes of all present for a speedy recovery of his father. Favorable action having been taken on the applications of Joseph E. Thompson, active, and LeVerne Verzier, associate membership, they were declared elected. Application for associate membership was received from Jesse Edwin Starek, of the United Chromium, Inc. George Muscio, instructor of the chemistry class, reported progress for same.

Past President Wm. Gray remarked on the subject of the paper to be presented by Waterbury Branch at the coming convention in New York City. Among those present at the meeting, was Edwin Stevenson, an old lacquer friend. Being called upon by President Elwin to tell the boys something about the lacquer business in days gone by, it goes without saying that "Stevie" made a good job of it. It was announced that Donald Wood of Boston, would be the speaker at the February 12th meeting.

It was with much sorrow that the many friends of Vice-President Patrick J. Sheehan learned of his death in Milwaukee. Mr. Sheehan was a resident of Waterbury and left for the West about twenty-five years ago. While living here, he took an active part in the athletics of the city, being a member of the Old Elm football team, which had an enviable record at that time.

WM. F. GUILFOILE, *Sec.*

LOS ANGELES BRANCH

Minutes of the regular monthly meeting of the Los Angeles Branch A.E.S. held December 9th, 1936, at the Rosslyn Hotel. President E. R. Williams presided. Twelve members were present. Minutes and financial report of the previous meeting were read and accepted. Bills for secretary's fee and bond were read and ordered paid.

The question of the Branch having an educational meeting and dinner dance in February or March was discussed. The matter was left open until the January meeting.

The secretary was instructed to write a letter of condolence to Mrs. Gibson, whose husband, a former member of this Branch, had recently passed away.

Ray Solivan acted as librarian. He

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found the following questions in the box:

Q. In reclaiming silver from developing solutions in movie studios there is trouble with the silver depositing on the sides of the tank. The tanks are lined with pitch and the silver is plated out electrically. The trouble seems to occur mostly after the solution becomes weak in metal.

A. After some discussion it developed that as the solution became lower in metal it was moved from one tank to another and the trouble developed in the last tank of the series. It was suggested that in the last tank the silver might better be removed by precipitation instead of electrolysis. It was also suggested that the last tank of the series be re-lined as there might be some metallic particles stuck in the old lining that would attract the silver.

Q. How can lead contamination be removed from a nickel solution?

No answer.

Q. Does any one know of a black plate that doesn't have to be lacquered?

A. No one knew of a black finish that didn't have to be either lacquered or waxed.

EARL COFFIN, *Sec.-Treas.*

BOSTON BRANCH

Boston Branch met Thursday, Jan. 7th, at the Manger Hotel with Pres. Mintie in the chair.

Minutes of the previous meeting read, approved. Bills read and approved.

Communications read and placed on file. One was read from the Research Committee and it was moved that ten dollars be sent to the Research Fund.

Two applications were acted upon and elected to membership as follows: Allyn D. Chabot, P. O. Box 465, Putnam, Conn., and Charles A. Sleicher, 43 Oak Ave., Larchmont, N. Y.

The Chemistry Class started saturday, Jan. 9th, with twenty-five in the first class. The chairman, Charles O. Hardy, said that he will have fifteen more for next week.

The Banquet Committee made its report and the chairman, Louis Gale, said that this would be the best banquet the Branch ever held. He outlined what the program will be. The banquet will be held at the Bradford Hotel, Boston, Saturday, March 6, 1937 at 2 p.m. The educational session will be held in the Lobby Salon at 2 p.m., and the banquet at 7 p.m., also in the Lobby Salon, with a very fine floor show, and dancing until 12 p.m. Tickets will be $2.00 including the banquet. Now the chairman asks all the members to get together and make it the greatest time the Branch ever had. There will be three speakers and they have never been heard in Boston, W. M. Phillips of the Gen. Motors, and Mr. Ben McGar of the Chase Brass Co., and the other to be announced later.

A motion was made to put a telephone in the Secretary's home for the members of the committee.

We had with us as speaker of the evening, Dr. Klinkenstein of Maas, Waldstein Co. He spoke on the "New Developments in Lacquers." He was introduced by the acting librarian, Bert Sage. The Dr. gave a very interesting talk and had with him more than fifty different samples of finishes that were passed around to the members. As he passed them out he would explain how the different finishes were done, and he also spoke on the spotting out of work that has been lacquered. He told of some of the ways that they overcome

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this but some of the members thought that it can not be overcome. He answered all the questions for the members and they were plenty. They kept the Dr. busy for more than an hour. A rising vote of thanks was given the Dr. for his very interesting talk. The meeting adjourned at 11 p.m.

A. W. GARRETT, *Sec.*

CLEVELAND BRANCH

The regular monthly meeting of the Cleveland Branch of the American Electro-Platers' Society was held at Hotel Carter, Saturday, January 9th, 1937. The meeting was called to order by our president at 8:15 p.m. The minutes of the November meeting were approved as read.

There was one application for membership. Communications and bills took the regular course, outside of the one from New York Branch which was ordered read at each meeting.

Our December meeting was postponed and we had our first dinner and dance which went over with a bang. It was a very pleasant affair that brought together the members and their wives and also brought out a much better feeling of friendship inasmuch as we got better acquainted.

Motion was made for adjournment.

W. E. O'BERG, *Sec.-Treas.*

PITTSBURGH BRANCH

Our meeting of Friday evening, December 8th, was held in Webster Hall, with a dinner as usual. Instead of having a regular speaker to talk on plating problems, we had instead, moving pictures of the Canadian wilds and the many sports to be enjoyed in that district. The pictures were furnished by Mr. N. H. McKay, chairman of our membership committee. The members and their friends who were present spent a pleasant evening. Mr. McKay also handed in two new applications, both for associate membership, as follows: Mr. Richard O. Hummel, Harshaw Chemical Co., Pittsburgh, Pa.; Mr. Regis J. Golbach, Harshaw Chemical Co., Pittsburgh, Pa. As these gentlemen have been active in the welfare of the Branch and were well known, immediate action was taken, and they were duly recommended, upon a vote of the members.

Next meeting will be held Friday evening, Feb. 5th., and expect to have a subject that will interest all live platers. S. E. HEDDEN, *Sec.-Treas.*

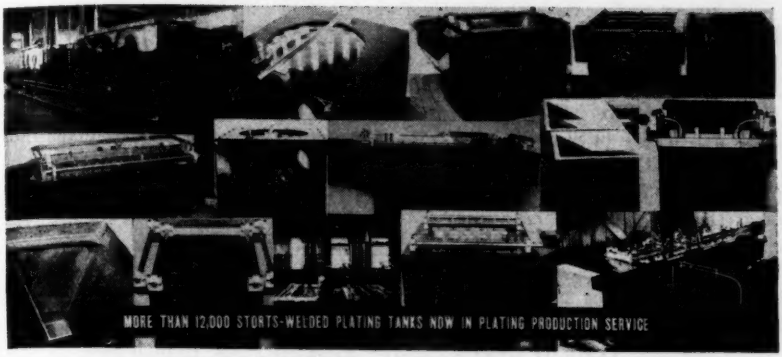
BALTIMORE-WASHINGTON BRANCH

We are pleased to announce that we received two applications for membership, from Raymond de Buyer, Managing Director of Societe de Traitements Electrolytiques — Procedes Pival, 30 rue Arthur Rozier, Paris 19° France; Jack Walter Ellert, 609 S. Regester St., Baltimore, Md. These have been referred to the Board of Managers and the election will come off at the next meeting.

The next business was our banquet, which is to be held on February 13. The Educational Session will be held at 2:30 in HOTEL RENNERT, Baltimore, Md., the same hotel where the banquet will be held at 7:00 p.m.

The entire program for the Educational Session is not complete at this time. Among the papers to be read are the following:

"New Magnetic Method for Testing the Thickness of Nickel Deposits on Non-Ferrous Metals"—by Abner Brenner; C. A. Vincent-Daviss and W. Blum, "The Use of Color Photography in Connection with Exposure Tests."



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While the Educational Session is in progress, the ladies will be taken care of at the movies. The entertainment committee has promised that this banquet will be one outstanding. A hearty invitation is extended to the friends of all branches of the A. E. S.

IRVIN H. HAHN, *Sec.*

HARTFORD BRANCH

The Hartford, Conn., Branch, A.E.S. held its regular monthly meeting on Monday evening, Jan. 11, 1937, at the Hartford State Trade School, 110 Washington St., Hartford, Conn.

The meeting was called to order at 8:15 p.m. with President Peterson in the chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file. No bills were presented.

Four applicants were elected to membership as follows:

Mr. N. E. Promisel, Associate, Meriden, Conn.; Mr. C. C. Tucker, Active, Terryville, Conn.; Mr. A. J. Maynard, Active, New Britain, Conn.; Mr. E. G. Garanson, Active, Forestville, Conn.

Three more applications were received for publication, these being as follows: Mr. L. C. Andrews, Active, New Britain, Conn.; Mr. H. C. Baum, Active, Plainville, Conn.; Mr. C. G. Bondeson, Associate, Terryville, Conn. This gives our Branch a very fine record to date in the Membership Drive.

The Branch was very much disappointed in the postponement of our speaker, due to unavoidable circumstances, he was unable to appear.

The Branch was shocked and grieved to hear of the death of Mr. P. J. Sheehan, Supreme Vice-President, and the secretary was instructed to send a letter of sympathy and condolence to Mrs. Sheehan and family.

The meeting was adjourned at 10:30 p.m.

V. E. GRANT, *Sec.*

GRAND RAPIDS BRANCH

Grand Rapids Branch held its first meeting of the new year January 14, and it was well attended.

The question of having an open dinner meeting with speaker and music for the purpose of interesting prospective members in Grand Rapids and vicinity in the A. E. S. was taken up. After much discussion Mr. Chas. Werft and Mr. Herbert Guldbrandsen were appointed to secure the needed information to meet the requirements of the occasion.

For the good of the order questions were, "how to eliminate excess sulphate in chrome solutions" and "the best way to reclaim silver from old solutions."

CHAS. S. WHALLEY, *Sec.*

DETROIT BRANCH

On January 8th, the Detroit Branch of the American Electro-Platers' Society held their first supper entertainment and dance. It was a very successful party, both socially and financially, there being a very good attendance, and everyone enjoyed himself. There were 260 suppers served. By this one can see how many there were in attendance.

The entertainment was of the highest class, furnished by the Fox Theatre, as was also the orchestra. In fact it was so good that the orchestra was asked for an extra hour's time. The party broke up at 1:00 a.m.

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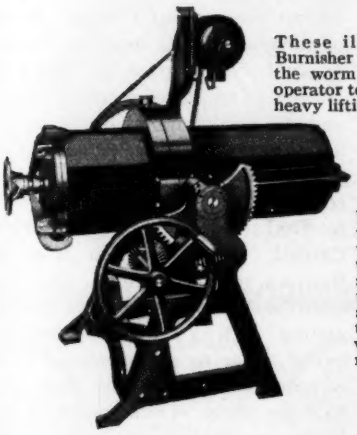

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The Committee in charge, with Mr. George L. Nankervis as Chairman, are to be congratulated.

We feel that this party was such a success that we are going ahead with plans for a picnic this summer, and then plans for a banquet to be held sometime during the next winter.

There having been no regular business meeting this month, the Board of Managers have passed on applications received for membership and they are hereby unanimously elected to membership.

T. C. EICHSTAEDT, *Sec.-Treas.*

ROCHESTER BRANCH

The Rochester Branch held its regular monthly meeting at the Seneca Hotel on Friday night, January 15. Regular business was transacted during which the committee in charge of the Bowling Party reported everything in readiness for a whale of a good time. Under new business it was suggested by the secretary that we hold a dinner meeting in February and on motion of Mr. Bruening, seconded by Mr. Kennedy it was so decided. The chair then appointed Mr. Frank Kolb as chairman with Mr. Del Rosso and Mr. Gartland to assist him, the meeting to be held on February 19th. Anyone wishing to attend should get their reservations in as soon as possible by writing Mr. Frank Kolb, 12 Churchlea Pl., Rochester, N. Y., or Mr. Judson R. Elster, 295 Rawlinson Rd., Rochester, N. Y. After a little further business, the meeting was turned over to the Educational Chairman Mr. John Honnecker and a discussion on copper took place. At a late hour the meeting was adjourned.

On Saturday night, January 23, the Annual Bowling Party was held at the Grand Webster Bowling Hall. The party was attended by a capacity crowd who divided their time between bowling, drinking, and eating, and a very enjoyable time was had by all.

JUDSON R. ELSTER, *Sec.*

PHILADELPHIA BRANCH

Philadelphia Branch held its regular stated meeting, President Al Hirsch presiding, January 15, 1937. All officers present but P. Uhl. Minutes of previous meeting read and approved as read. Application of Mr. Frank Harper as an active member. Moved and seconded application be received and referred to the Board of Managers. Carried. Communication Mr. Kennedy read, moved and seconded, same be received and requests be complied with. Carried. Communication from Mr. Barrows read and taken under the question box. Conclusion—copper plating with a heavy deposit and buffed, prior to nickel deposit is not as economical as to finish with a fine finishing wheel. Communication from Milwaukee Branch read; moved and seconded same be received and filed. Carried. Meeting then was turned over to Mr. Nelson, Chairman Educational Committee, for the discussion on Barrel Plating. Mr. D. Robson was appointed to take data on same. Discussions as the Branch is going to prepare a paper to be read at the Silver Jubilee Convention, in June, at New York. ATTENTION all members of Philadelphia Branch. It is imperative that you attend our next meeting, as we are going to hold another discussion on same at our February 19th meeting.

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Also Mr. Nelson has a very important message for you at this time.

The report of Banquet Committee which was an approximate report, received; moved and seconded same be given a rising vote of thanks. Carried. There being no further business, the meeting adjourned till February 19, 1937, at 8:00 p.m.

ROBERT E. JACKSON, JR., *Sec.-Treas.*

TORONTO BRANCH

Toronto Branch members enjoyed a great treat Monday evening, January 25th. The attendance was unusually large, everybody was in fine spirits and the feature of the evening was one of the best, if not the best talk we have heard at our Branch meetings. Mr. Archie Smith, a mild mannered, genial little fellow who is Chemist at the Coulter Brass & Copper works, Toronto, gave us a talk on "The Anodic Treatment of Aluminum". He told of reasons for the treatment; historical development; uses of various acids, etc. The Alumilite treatment, equipment, factors of vital importance, racks, rinsing, coloured work, sealing, etc. Properties of Coatings on Alloys. Applications of Alumilite treated materials. Alzac, its purpose and application, etc. The talk was illustrated by means of many specimens in various stages of treatment. Mr. Smith was deluged with questions following his truly fascinating talk. Mr. Smith abstained from the use of technical terms which so often mar the efforts of a good speaker when addressing Branch meetings and his talk was greatly enjoyed and appreciated by all.

David Ayers, one of our oldest members came up from Prescott, Ontario, and as we all love Dave we were delighted to have him with us. Arthur Ellis of Hamilton, Ont., was also present and told us that the rough finish on the brass domes he showed us in November was due to over annealing the brass, so that lets Arthur out on the right side.

Martin Robinson of Parkdale also arrived looking robust as ever.

Letters from N. Y. Branch and Milwaukee Branch regarding conventions were given special attention. The Membership Secretary presented two applications and reported use of form letters addressed to employers.

A committee was appointed to prepare for a social evening in March.

Our Canadian made buttons have arrived and are available gratis to all members of Toronto Branch. The hour of adjournment was late and those who were absent missed a treat.

Have you sent the Membership Secretary the name of a prospect? Do it now.

WALTER S. BARROWS, *Sec'y.*

PROVIDENCE-ATTLEBORO BRANCH

The regular meeting of Providence-Attleboro Branch, was held at the Narragansett Hotel, Friday, January 15, 1937.

Mr. Wm. J. R. Kennedy was present, and, after being introduced by Mr. Chace, gave us a very interesting talk on the present needs and aims of the Society. In reviewing the past history, he cited the present high standing of the Society as among other Science Bodies, in comparison to what it was a few years ago; indicating that membership in the Society is even more desirable than ever. He promised to co-operate with us in building up the Branch membership. There was a very interesting question period following Mr. Kennedy's talk. Mr. Wm. F. Cahill was presented and he gave a very interesting talk on "Cleaners",

The following papers will come from Philadelphia for the Convention. The titles are self explanatory, two papers are contributions; the first one will be made up from discussions at the Branch meetings; the second from a research, under the supervision of Albert Hirsch at the Jules Mastbaum School, Philadelphia, Pa.

"Discussion on Barrel Electroplating," contribution from Philadelphia Branch.

"Effect of Free Sodium Cyanide on the Cathode Efficiency of Silver Plating Solutions," a research conducted by the Electroplater's class, Jules Mastbaum Evening Vocational School, Philadelphia, Pa.

"Cathode Efficiency of Electroplating Barrels and its Effect on the Adhesion of Nickel Deposits," by Albert Hirsch, Electroplater and Chemist, Carey McFall Co., Philadelphia, Pa.

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reviewing the several types of cleaners as: The Degreasing Machine, The Still Tank or Solution, and the Electric-Cleaner, also the Electric Pickle, each having its sphere of usefulness and, the problem is, to put the right cleaner on the job.

There was lively interest in the question period.

There were 15 members present.

For the next meeting, Mr. Chace promised to talk on "Depositing on Non-Metallics", and to have some samples for inspection.

After a short social period we adjourned about eleven o'clock.

J. ANDREWS, *Sec.*

NEW YORK BRANCH

The New York Branch held two scheduled meetings during January at the Branch Headquarters, The Pennsylvania Hotel.

On Friday, January 8th, the Branch held the first meeting of the New Year. It was a business meeting during which several Branch matters were discussed and acted upon. But it was also one of unusual general interest for the members inasmuch as we had the honor of a visit from the new Executive Secretary of the A. E. S., Mr. W. J. R. Kennedy of Springfield, Mass., making his first appearance before N. Y. Branch since taking over his new office. Mr. Kennedy listened in during the course of our meeting and observed the routine of Branch procedure and ventured some suggestions at the conclusion of the business session. President Ralph Ligouri of the Branch called upon Mr. Kennedy to address the membership present. Mr. Kennedy responded with an impressive talk on the activities of the A. E. S., the progress of recent years, the coming Silver Jubilee Convention and remarks relative to suggested and possible changes in policy of the A. E. S. in time to come. At the conclusion of his remarks President Ligouri expressed the appreciation of the Branch to Mr. Kennedy for his visit and interest in general.

On Friday, January 22nd, the Branch held their monthly Educational session. Mr. Walter Meyer of the Works Laboratory of the General Electric Company was the lecturer of the evening. His subject was "Copper Plating". He covered several types of solutions and his talk was enhanced by a number of interesting slides thrown upon the screen showing various nature of deposits and crystal structure. Mr. Meyer's talk was very well received and he was plied with many questions relative to his subject. Upon concluding, Mr. Meyer was extended a rising vote of thanks for his splendid resumé and later joined in a general discussion on plating problems engaged in by the members present. There were four applications for membership in the Society received at these meetings.

On Friday, February 12th, the Branch will be favored with a lecture presented by Mr. Benj. H. McGar of the Chase Brass and Copper Company of Waterbury, Conn. We anticipate his visit with interest.

F. J. MACSTOKER, *Sec.*

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Membership Report

To January 18, 1937

ELECTIONS

Raymond D. George, Pratt & Whitney Co., East Hartford, Conn. Active, Hartford Branch

Edward J. Boyer, 221 West Cortland St., Groton, N. Y. Active, Rochester Branch

LeVerne Verzier, Lea Mfg. Co., Waterbury, Conn. Associate, Waterbury Branch

J. E. Thompson, 97 Holly Ave., Oakville, Conn. Active, Waterbury Branch

N. E. Promisel, International Silver Co. Laboratory, Meriden, Conn. Associate, Hartford Branch

Emil G. Goranson, 449 Washington St., Forestville, Conn. Active, Hartford Branch

Clarence C. Tucker, Oak St., Terryville, Conn. Active, Hartford Branch

Albert J. Maynard, 35 Glen St., New Britain, Conn. Active, Hartford Branch

Cecil F. Trembicki, 817 Merchants Road, Rochester, N. Y. Associate, Rochester Branch

Lawrence E. Clark, 528 Continental St., Detroit, Mich. Active, Detroit Branch

Werden D. Huffman, 13567 Cloverlawn Ave., Detroit, Mich. Active, Detroit Branch

Charles A. Sleicher, 43 Oak Ave., Larchmont, N. Y. Associate, Boston Branch

Allyn D. Chabot, P. O. Box 465, Putnam, Conn. Associate, Boston Branch

Regis J. Goldbach, Harshaw Chem. Co., 7th & Carson Sts., Philadelphia, Pa. Associate Pittsburgh, Branch

Richard O. Hummel, Harshaw Chem. Co., 7th & Carson Sts., Philadelphia, Pa. Associate, Pittsburgh Branch

Alfred W. Polasky, 4054 Beaufait, Detroit, Mich. Associate, Detroit Branch

A. E. Jackson, 282 E. Ferry Ave., Detroit, Mich. Associate, Detroit Branch

William Hodson, Jr., 7310 Woodward Ave., Detroit, Mich. Associate, Detroit Branch

Peter Hoeffel, 15389 Holmar Ave., Detroit, Mich. Associate, Detroit Branch

Richard B. Saltonstall, Udylite Co., 1651 E. Grand Blvd., Detroit, Mich. Associate, Detroit Branch

G. R. Kentta, Udylite Co., 1651 E. Grand Blvd., Detroit, Mich. Associate, Detroit Branch

W. H. Davis, 16156 Steel Avenue, Detroit, Mich. Associate, Detroit Branch